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PULP&PAPER

1992 NORTH AMERICAN FACT BOOK

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Contributing Editors:

Willard E. Mies
Debra A. Garcia
Rob Galin
Carl P. Espe
Noel DeKing
Sophie Wilkinson
Mark A. Weintraub
Jim McLaren
Virginia Stefan
Mary Corbett

Managing Editor:

Marta L. Dils

Production Editor:

Rose Tobin

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comprehensive review of the structure and status
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the United States and Canada. Every effort
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To the best of the editors' knowledge,
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Editors: Debra A. Garcia
Rob Galin
Carl P. Espe
Noel DeKing
Sophie Wilkinson
Mark A. Weintraub
Jim McLaren
Virginia Stefan
Mary Corbett

Editorial Offices:
600 Harrison Street, San Francisco, CA 94107
Telephone: (415) 905-2200
Fax: (415) 905-2240

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NORTH AMERICAN OVERVIEW

North America is the world's most important pulp- and paper-producing region, accounting for about 50% of worldwide pulpmaking capacity and 40% of paper and paperboard capacity.

Paper and paperboard production has just about matched general economic activity during the 1980s. Printing/writing grades have shown strong growth because of the spread of smaller computers and the demand for higher-quality paper in advertising. Packaging grades have shown somewhat slower growth due to inroads by plastics in some market segments. Industry profitability improved strongly during the latter part of the decade, helped by favorable market conditions and the decline of the dollar.

The North American Overview is divided into two sections: United States and Canada. For each country, there is a chapter that examines trends in industry structure, production, exports/imports, prices, profitability, capital spending, capacity expansion, mergers and acquisitions, labor, timber resources, energy use, transportation, and environmental spending and regulations.

Financial data:	In U.S. section, all sales and earnings figures are in U.S. dollars unless indicated "C$" for Canadian dollars. In Canadian section, all sales and earnings figures are in Canadian dollars unless indicated "US$" for U.S. dollars.
Production data:	All capacity production data are set in short tons of 2,000 lb, unless specifically indicated as metric. To convert to metric tons—multiply by 0.90718. To convert to short tons—multiply by 1.1023.

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United States:

INDUSTRY STRUCTURE

The U.S. paper industry avoided the well-publicized decline of "Smokestack America" in the 1980s, and it remains a low-cost producer in excellent position to compete at home and in world markets. By closing inefficient facilities, spending intensively to upgrade equipment, and winning concessions from its work force, the industry weathered two recessions at the beginning of the 1980s and the erosion of its markets when the dollar soared in the middle years of the decade. Tough measures taken during these down periods set the stage for a record surge in earnings during the second half of the 1980s, accompanied by a capacity expansion boom in several major grade segments.

As the industry entered the 1990s, the boom ended with slower markets and overcapacity, resulting in falling prices, lower earnings, and cutbacks in employment and investment. In the early 1990s, the industry will be working to digest all of the new capacity added recently and to restore its battered balance sheet. At the same time, the industry will need to invest in product quality improvements demanded by its customers and in equipment upgrades to comply with tougher environmental standards.

PAPER MACHINES IN OPERATION

	Number of machines 1989	1980	1975	Machine capacity* 1989
Newsprint	40	43	38	6,296
Printing/writing	421	452	475	23,637
Packaging	176	205	228	5,435
Tissue	203	236	240	5,798
Total paper	**840**	**919**	**981**	**41,166**
Unbleached kraft	67	74	69	20,878
Solid bleached	26	30	31	4,716
Semichemical	38	47	51	5,781
Recycled	187	209	244	9,617
Total paperboard	**318**	**360**	**395**	**40,992**
Total paper and board	**1,158**	**1,279**	**1,376**	**78,185**

*000 short tons.
Source: American Paper Institute.

According to the Commerce Dept., the paper and allied products industry ranks about tenth among all manufacturing industries in sales and investment. Sales of corporations totaled $115.5 billion in 1990, up 1.7% from 1989, while capital spending rose 7.3% to $16.5 billion. The value of paper and allied product shipments in 1990 was $131.1 billion, up 0.4% from 1989.

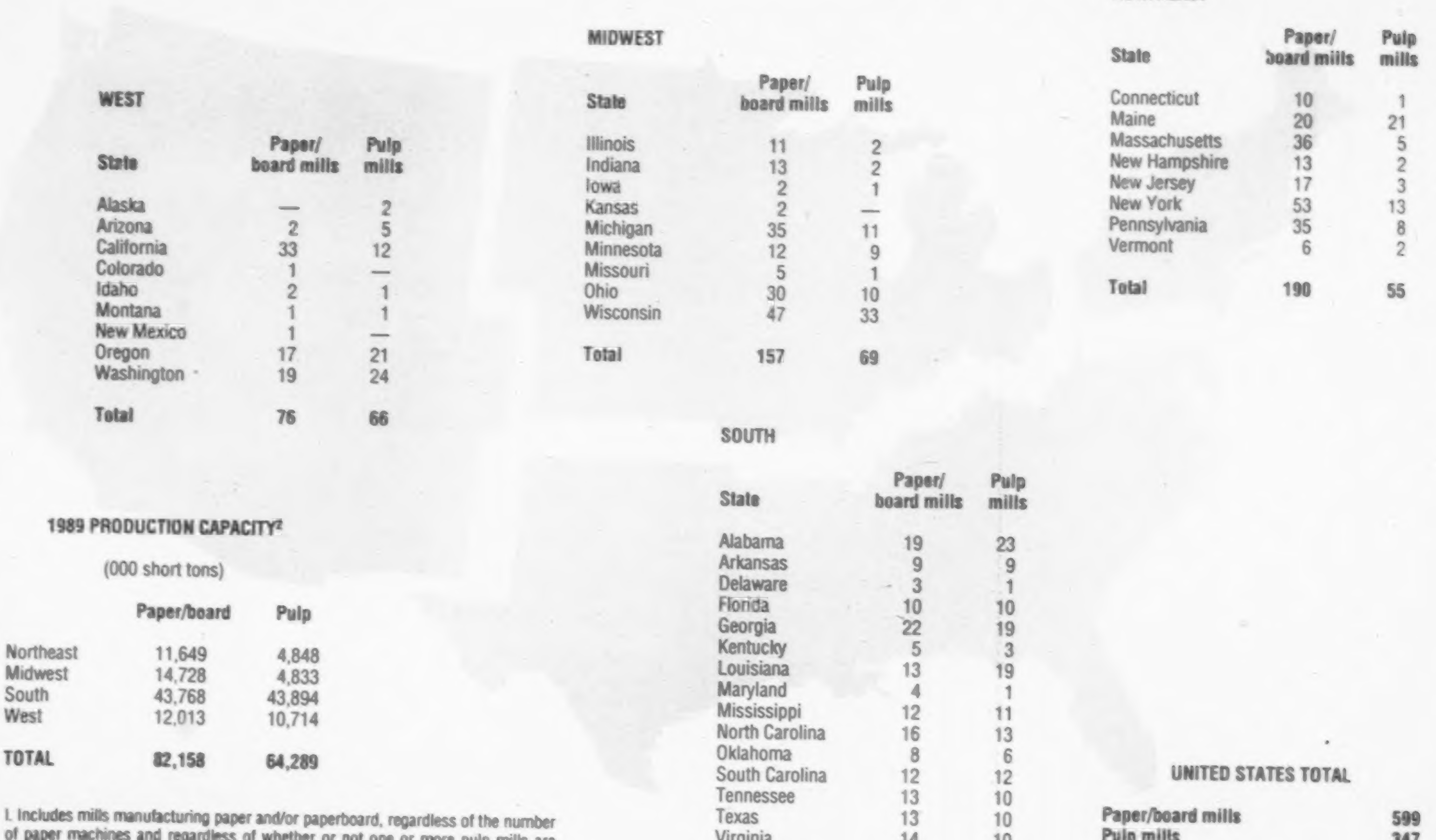
Ranked by sales of pulp, paper, and converted products, the largest company in the U.S. paper industry in 1990 was International Paper Co., with revenues of $10.6 billion. IP burst to the head of the pack in 1986 as a result of its purchase of Hammermill Paper Co. On the basis of its acquisition of Great Northern Nekoosa Corp., Georgia-Pacific Corp. jumped to second place with 1990 sales of $6.7 billion. Kimberly-Clark Corp. remained in third place with revenues of $6.2 billion, followed by Stone Container Corp.'s sales of $5.5 billion. James River Corp., which announced a major restructuring in 1990, dropped from second to fifth on sales of $5.4 billion.

The value of paper and allied products industry shipments increased every year in the second half of the 1980s, according to the Commerce Dept., finishing the decade with an anemic gain of 0.4% in 1990 to $131.1 billion. Shipments took off in 1986, growing 11.2% to $103.83 billion. And 1987 was even better, resulting in a 14.5% spurt to $118.86 billion. The punch went out of the cycle in 1988 as shipments grew 7.5% to $127.72 billion and just 2.2% in 1989 to $130.50 billion. Preliminary data for 1991 indicate a probable decline of over 7.0% to about $120 billion.

While primary production of pulp, paper, and paperboard represented 42% to 43% of the value of industry

NUMBER OF PULP, PAPER, AND BOARD MILLS IN U.S., BY REGION

(Number of mill sites)[1]



WEST

State	Paper/ board mills	Pulp mills
Alaska	—	2
Arizona	2	5
California	33	12
Colorado	1	—
Idaho	2	1
Montana	1	1
New Mexico	1	—
Oregon	17	21
Washington	19	24
Total	**76**	**66**

MIDWEST

State	Paper/ board mills	Pulp mills
Illinois	11	2
Indiana	13	2
Iowa	2	1
Kansas	2	—
Michigan	35	11
Minnesota	12	9
Missouri	5	1
Ohio	30	10
Wisconsin	47	33
Total	**157**	**69**

NORTHEAST

State	Paper/ board mills	Pulp mills
Connecticut	10	1
Maine	20	21
Massachusetts	36	5
New Hampshire	13	2
New Jersey	17	3
New York	53	13
Pennsylvania	35	8
Vermont	6	2
Total	**190**	**55**

SOUTH

State	Paper/ board mills	Pulp mills
Alabama	19	23
Arkansas	9	9
Delaware	3	1
Florida	10	10
Georgia	22	19
Kentucky	5	3
Louisiana	13	19
Maryland	4	1
Mississippi	12	11
North Carolina	16	13
Oklahoma	8	6
South Carolina	12	12
Tennessee	13	10
Texas	13	10
Virginia	14	10
West Virginia	2	—
Total	175	157

UNITED STATES TOTAL

Paper/board mills	**599**
Pulp mills	**347**

1989 PRODUCTION CAPACITY[2]

(000 short tons)

	Paper/board	Pulp
Northeast	11,649	4,848
Midwest	14,728	4,833
South	43,768	43,894
West	12,013	10,714
TOTAL	**82,158**	**64,289**

1. Includes mills manufacturing paper and/or paperboard, regardless of the number of paper machines and regardless of whether or not one or more pulp mills are located at the site.
2. Source: American Paper Institute. Excludes construction paper and board and woodpulp for this grade.
Source: *1991 Lockwood-Post's Directory.*

shipments for much of the 1980s, rising prices brought that share up to 45% in 1988 and 44% in the following year. For 1990, these sectors accounted for 43% of shipments, as prices for converted paper products and paperboard boxes and containers held up better than primary products.

In 1987, the latest year for which breakdowns are available, the value added by manufacturers of pulp, paper, and paperboard contributed 49% to the value of shipments, vs 51% for the cost of materials, according to revised figures from the Census of Manufactures. Within the sector, value added by manufacturers ranged from 49% for paper to 50% for paperboard and 53% for pulp.

CAPACITY LEADERS

Georgia-Pacific is the largest U.S. producer of paper, paperboard, and market pulp. G-P's capacity for paper and paperboard in 1990 was 7.4 million tons, or 6.8% of total industry capacity. G-P's market pulp capacity of 1.9 million tons gave it a 9.2% share for the year. The company is the largest market pulp producer in the world and the second largest producer of containerboard, behind Stone Container. G-P runs neck and neck with International Paper for the top spot in printing and writing papers.

International Paper has capacity for 7.2 million tons of paper and paperboard, giving it a 6.7% share of the U.S. market. IP is tops in white papers and has significant operations in containerboard and boxboard. The company's 1.0 million tons of market pulp capacity places it fourth behind G-P, Weyerhaeuser Co., and Procter & Gamble Co. with a 5.1% market share.

U.S. PAPER INDUSTRY VALUE OF SHIPMENTS RANKED WITH OTHER INDUSTRIES

(billion $)

	1987	1986	Change (%)
Nondurable goods industries [1]	$1,199.7	$1,078.3	11.3%
Food, kindred products	330.1	308.5	7.0
Tobacco products	20.8	19.1	8.9
Textile mill products	63.5	55.3	14.8
Paper and allied products	108.3	97.9	10.6
Chemicals and allied products	230.1	197.1	16.7
Petroleum and coal products	130.7	124.9	4.6
Rubber and plastics products	86.3	73.4	17.6
Durable goods industries[1]	1,280.5	1,182.0	8.3
Stone, clay, and glass products	60.9	57.3	6.3
Primary metals	120.2	105.6	13.8
Fabricated metal products	148.3	138.0	7.5
Machinery, excluding electrical	220.1	208.5	5.6
Electrical machinery	172.1	196.2	-12.3
Transportation equipment	332.5	313.8	6.0
Instruments and related products	108.3	61.9	75.0
Total manufactured goods	2,480.2	2,260.3	9.7

1. Includes industries not shown.
Source: U.S. Dept. of Commerce.

Stone Container ranked third in 1990 in paper and board capacity with 6.3 million tons, or 5.8% of the overall market. Stone has grown through a series of bold acquisitions into the world's largest producer of containerboard and kraft paper. The company is also a major producer of newsprint and market pulp thanks to its acquisition of Consolidated-Bathurst Inc. in 1989.

The fourth largest U.S. producer of paper and paperboard is Champion International Corp., with capacity for 4.4 million tons in 1990. Champion's strength lies in printing and writing papers, where it ranks third in both uncoated and coated free-sheet capacity. Weyerhaeuser follows in fifth place with tonnage of 4.1 million tons. Weyerhaeuser is the only company among the top five not to grow significantly through acquisitions in the last ten years. The company is a major producer of containerboard, market pulp, and white papers.

The North American paper industry continues to consolidate. The top ten market pulp producers held sway over 54% of capacity in 1990, up from 52% in 1989. And the top ten paper and paperboard manufacturers dominated the industry with a 42% share.

One of the most concentrated sectors is kraft paper, with 71% of total U.S. capacity in the hands of the top five producers in 1989 and 97% of capacity held by the top ten companies. The top five coated free-sheet manufacturers accounted for 66% of North American capacity in 1990, and the top ten were responsible for 99%. In the tissue sector, 75% of U.S. capacity is allocated to the top five producers in 1990, compared with 92% for the top ten.

Among the commodity grades, the top five kraft linerboard companies hold 50% of U.S. capacity, and the top ten account for 78%. In the uncoated free-sheet sector, the largest five companies represent 62% of capacity, and the leading ten hold 77%.

Concentration is also evident at the mill level. The overall number of paper and paperboard mills fell from 635 in 1980 to 538 in 1990. Most of the shutdowns were among the smallest mills, producing 50,000 tpy or less. The number of mills with capacity for 500,000 tpy or more grew from 20 in 1980 to 39 in 1990.

Large-scale mergers and acquisitions have slowed to a virtual standstill in the paper industry, especially when compared with the 1980s, when paper companies made fat targets for corporate raiders. Morgan Stanley lists nine big paper deals in 1986, five in both 1987 and 1988, and just two in 1989. The major deal of 1990 was Georgia-Pacific's hostile takeover of Great Northern Nekoosa, completed early in the year. Analysts generally applauded the $3.7-billion purchase, noting that although short-term performance would be rough, the long-term outlook was good.

Other recent M&A activity includes the merger of the U.S. operations of Jefferson Smurfit Corp. and Container Corp. of America, completed in December 1989. And the other major deal in 1989 was Stone Container's $2.2-billion purchase of Consolidated-Bathurst, Canada's fifth largest pulp and paper company.

TOP 25 NORTH AMERICAN PAPER/PRODUCTS COMPANIES 1990[1]

Ranking	Company	1990 sales[2] (million US$)	% change 1990/89	Net profit[3] (million US$)	% change 1990/89	1990 capacity (000 short tons/year)	
						market pulp	paper/board
1.	International Paper	$10,610	15.0%	$706	-18.3%	1,040	7,228
2.	Georgia-Pacific	6,702	65.8	335	-49.3	1,856	7,404
3.	Kimberly-Clark	6,205	11.3	432	2.0	240	1,333
4.	Stone Container	5,468	5.1	95	-66.8	745	6,270
5.	James River	5,416	-7.8	233	1.3	—	2,981
6.	Scott Paper	5,356	5.7	248	-17.9	—	2,675
7.	Mead	4,332	111.4	164	-30.2	285	2,445
8.	Champion International	4,103	1.6	246	-43.1	965	4,435
9.	Weyerhaeuser	3,931	-3.7	394	-34.4	1,710	4,117
10.	Jefferson Smurfit*	2,620	-0.8	22	-89.4	—	3,688
11.	Abitibi-Price	2,431	-4.5	-9	-114.1	—	2,338
12.	Boise Cascade	2,329	-6.5	75	-72.0	375	3,395
13.	Union Camp	2,182	1.6	230	-23.1	100	3,315
14.	Noranda Forest	2,180	-11.7	-81	-150.3	646	1,055
15.	Westvaco	2,179	4.9	188	-15.7	105	2,305
16.	Canadian Pacific Forest Products	1,725	-20.8	-8	-104.1	885	2,830
17.	Temple-Inland	1,517	0.7	233	12.6	100	2,640
18.	Domtar	1,458	-3.8	-82	-366.7	135	1,838
19.	MacMillan Bloedel	1,357	-12.7	44	-79.4	551	1,911
20.	Bowater	1,347	-4.9	87	-40.0	340	1,414
21.	Willamette Industries	1,294	4.5	130	-31.9	158	1,682
22.	Federal Paper Board	1,257	4.1	136	-34.0	550	1,065
23.	Sonoco Products*	1,252	0.8	105	1.9	—	970
24.	Fort Howard	1,151	9.2	-106	-10.9	—	1,030
25.	Packaging Corp. of America*	1,004	10.5	n.a.	—	—	2,110

*1989 sales from pulp and paper operations are estimated.

1. Canadian results have been converted to U.S. dollars and short tons.
2. Based on results from paper, pulp, and converting operations only.
3. Income from consolidated results, after taxes, and excluding nonrecurring items.

Sources: *1991 Pulp & Paper Company Profiles*; *Pulp & Paper International.*

U.S. CAPACITY INTEGRATED TO WOODPULP

(000 short tons)

	1988		1982		1976	
	Tons	%	Tons	%	Tons	%
Paper						
Newsprint	5,584	91.3%	5,212	92.2%	3,589	89.4%
Uncoated groundwood	1,382	79.7	1,515	91.5	1,093	83.5
Coated groundwood	4,209	96.8	3,093	95.4	2,218	96.5
Coated free-sheet	2,609	75.9	1,776	78.1	1,359	71.4
Uncoated free-sheet/ cotton fiber	9,397	77.9	7,384	80.3	4,837	64.8
Thin	81	28.7	106	28.7	57	15.9
Bristols	1,076	91.9	946	88.5	1,092	93.7
Packaging/industrial converting	3,945	73.0	4,887	80.4	5,071	81.8
Tissue	2,312	40.8	2,606	50.8	2,043	45.4
Total	30,596	76.1	27,525	79.4	21,359	73.1
Paperboard						
Unbleached kraft	20,269	100.0	17,402	100.0	14,568	100.0
Solid bleached	4,732	100.0	4,121	100.0	3,998	100.0
Semichemical	5,679	98.1	5,207	100.0	4,758	100.0
Recycled	774	8.1	346	4.0	513	5.8
Total	31,454	78.0	27,076	76.4	23,837	74.3
Total paper and board	62,050	77.0	54,601	77.9	45,196	73.7

Source: American Paper Institute.

U.S. MILL SIZE DISTRIBUTION FOR PAPER/BOARD AND WOODPULP

Mill capacity range (000 tpy)	Paper and paperboard				Woodpulp			
	Number of mills		Annual capacity (% share)		Number of mills		Annual capacity (% share)	
	1990	1980	1990	1980	1990	1980	1990	1980
0-25	125	205	2.0%	3.7%	14	30	0.3%	0.8%
26-50	84	115	3.7	6.0	13	29	0.8	2.0
51-75	69	70	5.2	6.2	13	19	1.3	2.2
76-100	39	42	4.1	5.2	11	17	1.4	2.8
101-125	29	43	3.9	6.9	14	12	2.4	2.5
126-150	24	16	3.9	3.2	10	9	2.1	2.7
151-175	13	15	2.5	3.7	8	14	2.0	4.2
176-200	18	20	4.1	5.6	6	10	1.7	3.8
201-250	28	23	7.4	7.7	22	19	7.5	7.5
251-300	21	13	6.9	5.0	12	17	5.1	8.0
301-350	9	15	3.5	6.9	11	7	5.5	4.7
351-400	13	18	5.8	9.5	11	13	6.3	8.8
401-450	10	12	5.0	7.2	9	13	5.9	9.9
451-500	17	8	9.5	5.3	14	14	10.3	12.0
Over 500	39	20	32.5	18.0	46	25	47.2	28.1
Total	**538**	**635**	**100.0**	**100.0**	**214**	**248**	**99.8**	**100.0**

Source: American Paper Institute.

United States:

PRODUCTION, EXPORTS, AND IMPORTS

Growth in paper and paperboard production continued through the first half of 1991, yet at a rate slightly less than that of first-half 1990. If output continues at the rate shown through the first half, the industry will produce over 81 million tons by year end, a 0.1% decrease from last year, according to the American Paper Institute. The seasonally adjusted annual rate for paper production was 38.8 million tons, down 1.0% from last year's total, while paperboard production was up 0.9% to 39.4 million tons.

Paper production growth in the first half of 1991 was led by newsprint, which was 4.6% above mid-year tallies in 1990. Slow second-quarter growth was followed by increased demand in June and July, primarily in the domestic newsprint industry.

Shipments and total purchases of printing and writing grades moved up sharply in July, with most of the gain in uncoated free-sheet papers. New orders for these grades exceeded 1 million tons each month since May, while shipments spurted up 13% from June to July. Increased bond paper demand accounts for the strength in these grades. Shipments of total bond and writing papers were up 6.9% in first-half 1991, while most of the other printing/writing grades fell behind their totals from the first half of last year. Growth in coated groundwood papers was down 3.3% in first-half 1991, reflecting diminished magazine advertising. Coated free-sheet papers, however, rose sharply in July in response to strong demand by catalog publishers.

Tissue production was ahead of record-high 1990 levels through April but fell in the subsequent three months, totaling a rate 1% lower than last year's January-July rate. Unbleached kraft paper shipments were down 2.9%, with some of the slack taken up by bags made partly from recovered papers, while bleached kraft papers were down 15%.

Paperboard production in first-half 1991 was led by unbleached kraft folding boxboard, which surged 21%. Folding boxboard overall was up 6% in the first seven months of 1991. Production of containerboard came within 0.3% of its 1990 rate in first-half 1991 due to a resurgence in shipments of fiber boxes. Declines in output of other boxboard grades can be traced to demand for nonpackaging grades.

U.S. woodpulp manufacturing rose 1.6% to 63.2 million tons in first-half 1991, compared with the same period in 1990. Groundwood and thermomechanical grades did best, racking up a 4.0% advance, while semichemical did least well, dropping off 3.8%.

Paper and board exports were up 20.3% in first-half 1991 over first-half 1990, heading for an annual rate of 6.9 million tons. Paper exports rose 29.3% in that period, while the more dominant board exports did even better. Other unbleached kraft grades grew 47.9%. Uncoated groundwood led the rise with a 70.8% increase. Woodpulp exports in the first half rose 9.2%, for an annual rate of 6.5 million tons.

Imports were down 6.5% through July 1991, aiming for an annual rate of 17.3 million tons. Wastepaper imports declined the least, at 1.4%, while imports of other fibrous materials declined 42.4%. Imports of paperboard grew overall by 6.0% in first-half 1991. Woodpulp imports were down 6.6%, heading toward an annual rate of 4.9 million tons.

Exports from the U.S. to Canada of paper and board rose 15.3% in first-half 1991 over the same period last year, with both tissue and newsprint doing extremely well. If shipments to Canada continue at that rate, the exports will total 1.3 million tons in 1991.

U.S. paper and board imports from Canada declined 7.3% through July 1991, compared with the same period in 1990, for an annualized rate of 10.4 million tons. Shipments of paperboard were up 10.2% overall, while printing and writing grades rose only 0.3%. Newsprint imports from Canada, which held fairly steady last year, declined 9.7% in first-half 1991. Woodpulp imports from Canada were up 1.2% over first-half 1990.

HISTORICAL PRODUCTION TRENDS

Paper and paperboard production grew fairly steadily after the recession in the mid-1970s, topping out at 61.3 million tons in 1979 and then turning down in the recession year of 1980. While production jumped 1.8% in 1981, another recession began toward the end of the year. That pushed production in the following year down to its lowest level since 1978, a decline of 4.5% to 59.5 million tons.

The rebound that followed in 1983 brought production up 9.3% to a record 65.0 million tons, 4.4% above the previous record of 62.3 million tons two years before. Then in 1984, output rose a further 5.8% to 68.8 million tons, although business slacked off in the last quarter. As growth slowed and the dollar strengthened in the next year—making exports expensive overseas and imports cheap in the U.S., production dropped 2.0% to 67.0 million tons.

In third-quarter 1985, the dollar began its long drop against many world currencies, a trend that continued through 1987. In response to strengthening domestic demand, particularly among consumers, paper and board production jumped 5.6% to 70.9 million tons in 1986.

Corrugated box shipments increased by 6% and folding cartons by 4%, reflecting strong gains in market segments such as appliance and television production. And the printing/writing paper sector showed gains of 6.5% in shipments in response to higher printing activity and increased demand for office papers.

Performance was strong again in 1987, with production rising 5.0% to 74.5 million tons, buoyed by a 9.7% spurt in coated paper shipments and a 7.4% hike in unbleached kraft linerboard production. Offices used more copy paper, envelopes, and computer printout, and printing paper benefited from growth in direct mail. Uncoated free-sheet shipments bumped up 5.5%, while newsprint production grew 3.8% to a record 5.8 million tons.

A third set of record highs characterized 1988. While production growth slowed, it still managed to reach 76.5 million tons, an increase of 2.9%. And market pulp output grew 4.4% to 8.5 million tons. The October 1987 stock market crash put jitters in the industry but was not followed by the anticipated recession. On the contrary, the economy

U.S. PAPER AND BOARD PRODUCTION BY MAJOR GRADE, 1986-90

	(000 short tons)					(Percent change)				
	1990	1989	1988	1987	1986	1990/89	1989/88	1988/87	1987/86	1986/85
Paper										
Newsprint	6,610	6,088	5,982	5,842	5,630	9.0%	1.8%	2.4%	3.8%	3.7%
Printing/writing	22,371	21,626	21,857	20,778	19,668	3.4	-1.1	5.2	5.6	6.8
Uncoated groundwood (s)	1,806	1,743	1,624	1,498	1,540	3.6	7.3	8.4	-2.7	1.2
Coated paper (s)	7,536	7,215	7,359	6,860	6,263	4.4	-2.0	7.3	9.5	6.6
Uncoated free-sheet (s)	11,475	11,081	11,277	10,966	10,410	3.6	-1.7	2.8	5.3	7.4
Thin paper	234	262	281	240	271	-10.7	-6.8	17.1	-11.4	3.4
Cotton fiber (s)	155	161	167	163	152	-3.7	-3.6	2.5	7.2	5.6
Bleached bristol (s)	1,152	1,164	1,150	1,052	1,033	-1.0	1.2	9.3	1.8	6.5
Tissue paper	5,802	5,636	5,476	5,301	5,095	2.9	2.9	3.3	4.0	3.1
Packaging and industrial converting (s)	4,576	4,916	5,047	4,955	5,117	-6.9	-2.6	1.9	-3.2	-1.7
Unbleached kraft paper (s)	2,377	2,681	2,800	2,840	3,303	-11.3	-4.3	-1.4	-14.0	
Other paper	2,200	2,236	2,247	2,115	1,814	-1.6	-0.5	6.2	16.6	
Total paper	39,359	38,266	38,363	36,876	35,510	2.9	-0.3	4.0	3.8	4.3
Paperboard										
Unbleached kraft linerboard	19,387	18,503	17,897	17,683	16,402	4.8	3.4	1.2	7.8	8.0
Other unbleached kraft paperboard	970	987	1,243	1,215	1,287	-1.7	-20.6	2.3	-5.6	8.7
Semichemical paperboard	5,710	5,691	5,664	5,536	5,376	0.3	0.5	2.3	3.0	5.7
Solid bleached	4,399	4,521	4,511	4,406	4,222	-2.7	0.2	2.4	4.4	6.9
Recycled	8,956	8,817	8,788	8,601	8,092	1.6	0.3	2.2	6.3	6.1
Total paperboard	39,423	38,519	38,103	37,442	35,379	2.3	1.1	1.8	5.8	7.1
Total paper and paperboard	78,748	76,785	76,466	74,318	70,889	2.6	0.4	2.9	4.8	5.7
Construction and wet machine	n.a.	n.a.	n.a.	1,600	1,600	—	—	—	—	-5.9
Total	n.a.	n.a.	n.a.	75,918	72,489	—	—	—	4.7	5.4

Note: Data may not add to totals because of rounding.
(s) = Shipments.
n.a. = Not available.
Source: American Paper Institute

grew 4.4% in 1988.

The printing/writing sector put on a 4.9% hike that year, aided by demand among magazine publishers and commercial printers, who brought about a 7.3% rise in coated paper output.

The paperboard sector did not do as well, rising just 1.8% in 1988, although production of solid bleached grades rose 2.4%. And unbleached kraft linerboard grew just 1.2% after two years of strong growth. U.S. fiber box shipments grew 3.2%, and production of containerboard for the U.S. climbed 2.2%.

After three years of strong growth and record output, paper and paperboard production flattened in 1989, rising only slightly to 76.6 million tons, according to API figures. Paper production was 38.2 million tpy—less than 1% below a year earlier. Paperboard output was 38.5 million tpy—up 1% from 1988.

Last year, paper and paperboard production lagged behind the general economy, which has cooled since 1988 yet still grew 3.0% in 1989. Paper inventory reductions helped flatten output in first-half 1989, but production picked up in the second half, with corrections in printing/writing grade inventories essentially complete. And despite the slowdown, the industry is not expected to repeat the slump of the early 1980s. Paper firms put a record $15 billion into new paper machines and related process equipment in 1989, which helped to bring operating rates down 2% to 93%.

Tissue paper came through with the strongest production performance among major sectors in 1989, growing 2.9%. In the printing/writing sector, which dropped 1.5% overall, uncoated groundwood production did best, with a jump of 8.0%, but thin paper was dismal, falling 12.8%. Uncoated free-sheet, which dipped 2.1%, suffered from major expansions, price cuts, and the after-effects of panic buying in the midst of continuous price hikes earlier in the 1980s. Coated paper also faced low operating rates in 1989 as a result of new capacity. Paperboard was more consistently positive than paper, led by unbleached kraft paperboard's 1.8% growth.

U.S. WOODPULP PRODUCTION BY MAJOR GRADES, 1984-90

(000 short tons)

	1990	1989	1988	1987	1986	1985	1984
Woodpulp							
Bleached sulfite	1,264	1,245	1,365	1,269	1,275	1,364	1,359
Unbleached sulfite	152	173	195	171	164	196	259
Total sulfite	1,416	1,418	1,560	1,440	1,439	1,560	1,618
Bleached and semibleached sulfate	25,004	24,448	26,302	25,411	24,158	22,626	22,350
Unbleached sulfate	20,024	19,658	21,631	21,442	20,481	19,510	20,721
Total white pulp* (bleached sulfite + bleached and semibleached sulfate)	26,420	25,866	27,667	26,680	25,433	23,990	23,709
Total chemical paper-grade (total sulfite + bleached and semibleached sulfate + unbleached sulfate	46,444	45,524	49.493	48,293	46,078	43,696	44,689
Semichemical	3,828	3,958	4,358	4,246	4,191	4,026	4,069
Mechanical	5,772	5,469	5,943	5,702	5,476	5,251	5,506
Total paper-grade	56,044	54,951	59,794	58,241	55,745	52,973	54,264
Dissolving, special alpha	1,173	1,293	1,367	1,312	1,257	1,174	1,206
Total woodpulp	63,068	56,244	61,161	59,553	57,002	54,147	55,470
Market pulp							
Chemical paper-grade	7,506	7,242	7,200	6,806	6,316	5,613	5,680
Groundwood, other	0	0	0	0	5	15	15
Dissolving	1,292	1,422	1,365	1,308	1,251	1,172	1,204
Total market pulp	8,798	8,664	8,565	8,114	7,572	6,800	6,899
Operating rates (%)							
Total white pulp	98.6	99.0	99.0	98.5	97.5	95.6	99.6
Total paper-grade	96.6	96.5	97.3	97.4	95.5	88.9	92.0
Dissolving/special alpha	84.8	95.3	94.3	94.5	89.8	80.7	81.1

*Includes small amount of unbleached sulfite after 1988.
Source: American Paper Institute.

EXPORTS

U.S. exports rise and fall with exchange rates. When the dollar reached a low relative to other major currencies in 1980, pulp and paper exports—including wastepaper and converted products—hit 11.8 million tons, an explosive increase of 31.9%.

But a rising dollar began to take its toll in 1981, and although the value of exports rose 1.4%, volume dropped 9.9%. In the following recessionary year, export value plunged 11.9% as prices dropped and the dollar strengthened, and volume sank 7.4%.

Prices rose and the currency remained strong in 1983, so in that year shipment value was off 2.2%. But exports responded to more vigorous demand and grew 10.3%.

In 1984, although the increasing might of the dollar held back industry performance, strong overseas demand pushed up exports 14.7% to 12.3 million tons. Action in the different sectors was uneven, to say the least, including a 70.4% surge in wastepaper shipments and a drop in paperboard exports of 6.7%. Pulp exports shrank 1.4%. Overall, the value of shipments for paper, board, and converted products rose 7.2%.

The dollar hit a high against other currencies in 1985, and world markets also softened, drawing down export volume 3.4% and value by 10.7%. Relief occurred in 1986, when demand reappeared and the currency began to slide down,

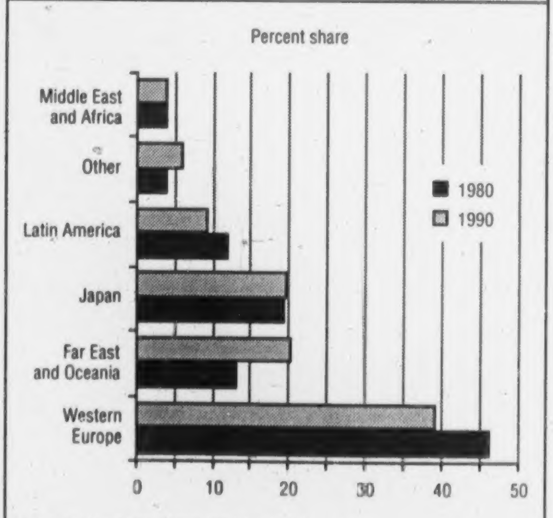
OPERATING RATES FOR MAJOR GRADE SEGMENTS

(Production or shipments/annual capacity)

	1990	1989	1988	1987	1986
Paper					
Newsprint	96.8%	96.9%	97.8%	97.3%	97.0%
Printing/writing (s)	93.4	90.5	94.9	94.1	93.5
Tissue	97.1	97.8	96.6	96.3	93.1
Packaging/industrial converting (s)	83.7	90.0	93.4	92.4	88.9
Total paper	93.2	92.4	95.4	94.7	93.3
Paperboard					
Unbleached kraft	95.4	93.4	94.4	97.3	94.8
Semichemical	97.7	96.2	97.9	97.5	96.7
Solid bleached	95.2	95.7	95.3	93.1	93.3
Recycled	89.3	91.1	92.2	92.8	89.7
Total paperboard	94.3	93.5	94.5	95.8	93.8
Total paper and paperboard	93.7	93.0	94.9	95.2	93.5

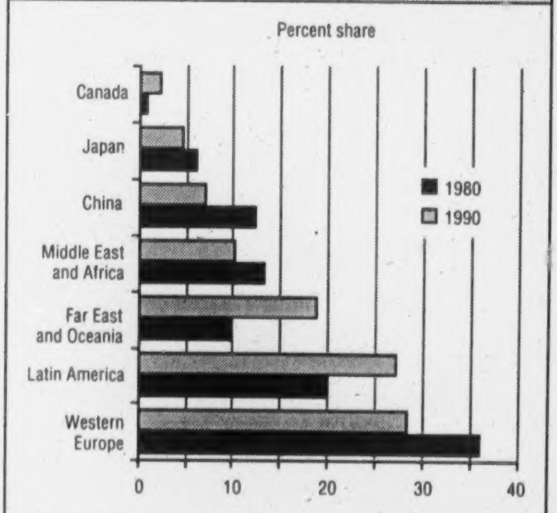
(s) = Shipments.
Source: American Paper Institute.

WOODPULP EXPORTS BY DESTINATION



Source: American Paper Institute.

KRAFT LINERBOARD EXPORTS BY DESTINATION



Source: American Paper Institute.

eventually settling in 1987 at about half its rate in 1985. This proved a boon to U.S. suppliers, shoring up 1986 exports 9.1% to 12.9 million tons and bouncing their value up 16.2%. Kraft linerboard dominated paperboard exports, which grew a whopping 21.8%. Pulp showed a respectable 17.5% increase, although wastepaper showed a 7.9% sag.

The following year, as weakness in the dollar continued, exports grew another 12.1% to 14.5 million tons, and record prices brought shipment value up 27.8%. Wastepaper rebounded, up 18.0%, pulp exports rose 9.7%, and paperboard improved 6.7%.

In spite of a more robust currency starting in second-quarter 1988, exports of paper and paperboard hit a new record at 4.7 million tons, for a rise of 6.1%. Value of those shipments grew 18.4% to $2.6 billion. Woodpulp performed especially well, with exports of a record 5.5 million tons accounting for a 29.0% hike in value to $2.9 billion.

Paper also did well, with volume growing 19.7% over 1987 figures to 1.1 million tons and value jumping 27.0% to $987 million. Newsprint was the most significant export grade; it also performed best among paper segments by growing 25.6%. Shipments in the sector hit 427,000 tons. Paperboard exports in 1988 did not do as well, however. Lower shipments of containerboard and recycled board

HISTORICAL U.S. PAPER AND BOARD PRODUCTION, CAPACITY, AND OPERATING RATES, 1960-90

(000 short tons)

	Production				Capacity		Operating rate
Year	Paper	Paperboard	Total paper/ board[1]	Change (%)	Total paper/ board[1]	Change (%)	Total paper/ board
1990	39,359	39,423	78,782	2.6%	85,597	2.6%	92.0%
1989	38,266	38,519	76,785	0.4	83,432	3.6	92.0
1988	38,363	38,103	76,466	2.9	80,533	3.0	94.9
1987	36,876	37,442	74,318	4.8	78,186	3.2	95.1
1986	35,510	35,379	70,889	5.9	75,777	2.0	93.5
1985	34,036	32,922	66,958	-2.2	74,301	1.6	90.1
1984	34,466	34,002	68,468	5.4	73,098	2.8	93.7
1983	32,816	32,145	64,961	9.6	71,126	1.5	91.3
1982	30,252	29,044	59,296	-4.5	70,086	2.8	84.6
1981	30,901	31,208	62,109	1.7	68,172	2.7	91.1
1980	30,116	30,926	61,042	0.0	66,368	2.7	92.0
1979	29,666	31,404	61,070	4.3	64,615	2.4	94.5
1978	28,320	30,252	58,572	3.4	63,091	1.8	92.8
1977	27,721	28,935	56,656	3.0	62,004	1.1	91.4
1976	26,577	28,415	54,992	14.6	61,307	1.9	89.7
1975	23,260	24,737	47,997	-13.9	60,140	1.0	79.8
1974	26,863	28,894	55,757	-1.0	59,527	2.3	93.7
1973	26,797	29,550	56,347	4.7	58,164	4.1	96.9
1972	25,359	28,484	53,843	8.2	55,873	3.2	96.4
1971	23,722	26,019	49,741	2.1	54,136	1.6	91.9
1970	23,351	25,367	48,718	-2.2	53,260	0.3	91.5
1969	23,449	26,362	49,811	5.8	53,094	3.8	93.8
1968	22,181	24,890	47,071	7.6	51,147	4.7	92.0
1967	20,926	22,819	43,745	-0.4	48,850	4.8	89.5
1966	20,725	23,179	43,904	8.4	46,608	7.1	94.2
1965	19,157	21,332	40,489	6.4	43,535	4.6	93.0
1964	18,112	19,954	38,066	6.0	41,623	3.7	91.5
1963	17,320	18,594	35,914	4.4	40,143	3.4	89.5
1962	16,560	17,847	34,407	5.7	38,810	1.3	88.7
1961	15,821	16,727	32,548	4.3	38,299	4.0	85.0
1960	15,295	15,926	31,221	15.4	36,840	3.1	84.7
Average annual change	1980-89			2.4		2.5	
	1970-79			2.3		2.0	
	1960-69			6.4		4.0	

1. Excludes hard pressed board, construction paper and board, and wet machine board.
Source: American Paper Institute.

held the sector down to 3.6 million tons—a 2.5% increase.

Paper and paperboard exports set yet another record in 1989, rising 10.1% to 5.2 million tons, with a solid increase in value of 12.8% to $3.0 billion. The dollar peaked in midyear, and a weakening economy then pushed the currency back down.

Paper shipments abroad put in a strong performance, expanding 33% to 1.5 million tons, while the value of these exports rose 24.9% to $1.2 billion. Much of that increase was due to newsprint and printing/writing grades, while tissue and packaging/industrial paper shipments out of the U.S. slacked off. Printing and writing grades put in a stellar performance, jumping 66.6% and growing in value 48.6%.

Paperboard shipments of 3.8 million tons outpaced 1988 performance by a mere 3.2%, and value growth of 5.5% to $1.7 billion was not much better. Kraft linerboard exports spurted up, but recycled paperboard held the sector back.

Pulp exports of 6.2 million tons reflected growth of 12.7%, outpaced by value growth of 20.5% to $3.5 billion, due principally to price increases.

HISTORICAL U.S. WOODPULP PRODUCTION, CAPACITY, AND OPERATING RATES

(000 short tons)

Year	Production Total*	 Captive	 Market	Total* capacity	Operating rate
1990	63,068	54,270	8,798	66,048	95.4%
1989	61,998	53,334	8,664	64,284	96.4
1988	61,161	52,596	8,565	62,946	97.2
1987	59,552	51,438	8,114	61,166	97.4
1986	57,002	49,429	7,573	59,743	95.4
1985	54,147	47,347	6,800	58,612	92.4
1984	55,471	48,572	6,899	57,713	96.1
1983	52,454	45,928	6,526	56,112	93.5
1982	49,334	43,602	5,732	56,091	88.0
1981	52,042	45,839	6,203	54,833	94.9
1980	50,734	44,269	6,465	53,154	95.4
1979	49,366	44,688	4,678	51,574	95.7
1978	46,888	41,726	5,162	49,723	94.3
1977	46,648	41,828	4,820	49,839	93.6
1976	45,385	40,515	4,870	48,681	93.2
1975	40,584	36,240	4,344	46,575	87.1

*Includes paper-grade, dissolving/special alpha pulps but excludes defibrated/exploded pulps, screenings, and fiber other than wood.
Source: American Paper Institute.

TOP PRODUCING STATES IN 1987

(000 short tons)

Pulp		Paper		Paperboard	
Georgia	6,887	Wisconsin	4,266	Georgia	4,802
Alabama	6,397	Maine	3,252	Alabama	3,125
Louisiana	4,970	Washington	2,678	Louisiana	2,980
Washington	4,531	Alabama	2,541	Florida	2,096
Florida	3,710	Louisiana	1,935	Oregon	1,983
Texas	3,123	Pennsylvania	1,835	Virginia	1,858
North Carolina	3,112	New York	1,688	South Carolina	1,847
Oregon	3,070	Oregon	1,568	California	1,389
South Carolina	2,949	Michigan	1,555	Michigan	1,381
Virginia	2,897	Georgia	1,505	Tennessee	1,280

Note: Production figures for several top-producing states are excluded by the Dept. of Commerce to avoid revealing data for individual companies, biasing the above list against states with a small number of major producers. Such states include Texas, Mississippi, and South Carolina.
Source: Bureau of the Census.

IMPORTS

Exchange rates appear to have a different effect on imports than they do on exports. Unlike exports, imports rose dramatically as the dollar strengthened from 1983-85, and then they kept right on growing even when the currency retreated. One factor has been the European producers' reluctance to relinquish their U.S. market position in spite of the shift in the nation's currency. And the Canadian dollar has been even weaker than the declining U.S. dollar, contributing some of the robustness of the import market.

Canada accounted for about 79% of foreign shipments to the U.S. in 1990, down from 85% in 1989. Canada is the major source of U.S. newsprint supplies, although its share has dropped over the long term from 80% in 1950 to 63% in 1970 to about 59% in 1989. Canada is also the largest foreign supplier of U.S. woodpulp, with a 7% share of the U.S. market. Canada and the U.S., the two largest trading partners in the world, have agreed on a binational trade agreement that will eliminate tariffs for numerous paper and paperboard grades by 1993.

Tariffs on these designated products will be cut in five equal, annual stages.

Back in 1983, the strong dollar and a booming economy pushed up imports of paper, board, pulp, and converted products 12.1% to 12.7 million tons. And in 1984, imports jumped another 19.5% to 15.2 million tons. The printing/writing sector exploded, rising 51% in 1983 and reaching 2 million tons after a 78% boom the following year.

In the newsprint and market pulp import sectors, Canada dominates the scene, and in 1984 it boosted newsprint shipments to the U.S. 9.1% and pulp shipments 8.0%. Overseas producers also paid more attention to the U.S. market during this period, and their interest pushed overall newsprint imports up 14.1% and pulp imports up 9.7%.

In 1985, the market cooled off somewhat, bringing imports up a mere 3.2%, including a 5.2% hike in paper imports. Printing/writing papers dropped off 6.4%, although activity in this sector was still high by historical standards. The dollar remained strong, which was a benefit to producers outside North America but was no help for domestic manufacturers. While domestic demand for coated paper was strong, for example, a flood of European imports prevented U.S. manufacturers from raising prices.

Late in the year, the dollar dropped off, although imports still rose 4.0% in 1986. Printing/writing papers rebounded and grew 6.1%, and pulp imports posted a 2.6% rise, with Canadian pulp shipments to the U.S. growing 3.1%.

The dollar weakened further in 1987, while imports improved another 7.5%. Strong demand among commercial printers allowed European exporters to keep up shipments of printing/writing papers. Canada supplied half of the imports of this grade, as the Canadian dollar continued to weaken with respect to the U.S. currency. This helped to push up Canadian printing/writing shipments to the U.S. by 18.8%, while Canadian newsprint shipments grew 5.2%.

INVENTORY LEVELS FOR PULP, NEWSPRINT, AND CONTAINERBOARD

Year	Norscan producer pulp stocks[1] (000 metric tons)	U.S. consumer newsprint stocks[2] (000 metric tons)	(days)	U.S. containerboard inventories[3] (000 short tons)	(weeks)
1991					
June	1,611	1,410	48	2,637	5.3
Mar.	1,586	1,430	46	3,071	6.5
1990					
Dec.	1,359	1,226	41	2,526	6.5
Sept.	1,494	1,355	39	2,620	4.4
June	1,397	1,308	41	2,503	5.3
Mar.	1,392	1,256	37	2,626	5.8
1989					
Dec.	1,021	1,204	38	2,501	5.7
Sept.	994	1,324	37	2,642	5.6
June	773	1,300	42	2,475	5.5
Mar.	760	1,426	41	2,569	5.7
1988					
Dec.	666	1,469	46	2,487	5.3
Sept.	767	1,626	44	2,732	6.2
June	670	1,544	49	2,595	5.9
Mar.	805	1,512	44	2,589	5.8
1987					
Dec.	691	1,411	45	2,396	5.3
Sept.	856	1,509	41	2,437	5.5
June	795	1,405	44	2,383	5.6
Mar.	867	1,367	40	2,391	5.4
Year end					
1986	870	1,268	42	2,134	5.3
1985	1,329	1,394	46	2,469	6.6
1984	1,619	1,329	45	2,442	7.1
1983	1,207	1,179	42	2,415	6.5
1982	1,603	1,258	47	2,524	7.6
1981	1,430	1,477	56	2,729	9.4
1980	949	1,090	42	1,984	6.2
1979	616	877	34	1,979	6.2
1978	903	971	38	1,961	5.8
1977	2,083	1,071	43	2,437	7.2
1976	2,825	1,209	52	2,527	8.1
1975	2,011	911	44	2,185	7.2
1974	611	1,061	48	2,323	8.2
1973	629	757	32	1,595	4.7
1972	1,149	667	26	1,603	5.1
1971	1,618	885	38	1,639	5.7
1970	647	944	42	1,879	7.0
Year-end averages					
1980-89	1,139	1,308	45	2,408	6.5
1970-79	1,309	935	40	2,013	6.5

1. Chemical paper-grade market pulp stocks at North American/Scandinavian producer mills (source: American Paper Institute).
2. Estimated U.S. publisher stocks of newsprint and days of supply (source: Canadian Pulp & Paper Assn.).
3. Containerboard inventories at box plants and mills and weeks of supply (source: Fibre Box Assn.).

The next year witnessed a 16.7% increase in printing/writing papers to 2.8 million tons as domestic demand continued strong, although newsprint imports dropped 2.1% to 8.8 million tons. The largest suppliers of the printing/writing grades were Canada and Finland, with a concentration on uncoated groundwood and clay-coated papers.

Total paper and paperboard imports reached 12.4 million tons after an increase of 1.9% over 1987. Those shipments were worth $6.9 billion, reflecting a healthy 16.7% boost. Woodpulp import value alone grew 28.7% to $2.7 billion, carried by 5.0 million tons.

Strong European demand and a low dollar redirected the attention of overseas producers to their own markets. And as the value of the Canadian dollar moved up, Canadian producers—whose exports to the U.S. are priced in U.S. dollars—also shifted to other markets.

As the domestic market in the U.S. weakened some, paper and paperboard imports dropped off 0.5% in 1989, settling at 12.3 million tons—but at a value of $7.2 billion, they were worth 3.6% more than in 1988.

Just as printing/writing and newsprint grades were responsible for much of the increase in paper exports, they were responsible for much of the decrease in imports. In the printing/writing sector, API noted that shipments from Canada displaced those from overseas. Newsprint—the largest import sector—suffered from softening markets and

U.S. PAPER INDUSTRY EXPORTS, IMPORTS, AND NET TRADE BALANCE

	1990		1989		1988		1987	
	Tons (000)	Value (million $)	Tons (000)	Value (million $)	Tons (000)	Value (million $)	Tons (000)	Value (million $)
Exports								
Woodpulp	5,905	$3,156	6,231	$3,513	5,528	$2,915	4,889	$2,259
Paper	1,519	1,455	1,466	1,234	1,102	988	921	777
Newsprint	536	293	625	357	427	295	340	210
Printing/writing	665	718	478	465	287	313	249	243
Packaging and industrial	284	404	342	381	347	342	294	293
Tissue	35	40	21	30	41	37	38	31
Paperboard	4,220	1,988	3,758	1,734	3,642	1,644	3,551	1,445
Kraft linerboard	2,924	1,077	2,500	935	2,281	888	2,297	812
Other unbleached kraft paperboard	254	144	247	113	292	103	211	79
Semichemical medium	50	18	31	14	42	18	64	23
Bleached packaging paperboard	765	629	795	583	743	503	648	408
Recycled paperboard	227	121	185	88	283	133	331	123
Total paper/paperboard	5,739	3,443	5,224	2,968	4,745	2,632	4,472	2,222
Converted products	1,048	1,585	1,040	1,278	815	1,051	725	823
Construction and wet machine	9,871	6,494	36	15	132	69	107	59
Wastepaper	6,515	780	5,981	730	5,640	688	4,422	553
Cotton pulp and other fiber	136	105	122	101	202	112	182	91
Total industry exports	19,352	9,075	18,634	8,604	17,061	7,467	14,797	6,007
Imports								
Woodpulp	4,893	2,831	5,005	2,981	5,038	2,663	4,850	2,069
Paper	11,961	7,077	11,814	6,901	12,064	6,799	11,765	5,768
Newsprint	8,300	4,247	8,553	4,380	8,802	4,570	8,987	4,121
Printing/writing	3,105	2,248	2,733	1,996	2,860	1,949	2,410	1,412
Packaging and industrial	426	462	407	414	343	232	310	192
Tissue	131	119	121	111	60	48	58	43
Total paperboard	626	306	533	280	341	131	361	127
Total paper/paperboard	12,588	7,383	12,348	7,181	12,405	6,930	12,126	5,895
Converted products	419	1,000	562	1,098	383	964	402	933
Construction and wet machine	141	43	190	50	322	108	309	99
Wastepaper	123	26	173	33	161	27	127	19
Total industry imports	18,177	11,292	18,289	11,352	18,309	10,692	17,814	9,015
Net trade balance (deficit)								
Woodpulp	1,012	325	1,226	532	490	252	39	190
Paper/paperboard	(6,849)	(3,940)	(7,124)	(4,213)	(7,660)	(4,298)	(7,654)	(3,673)
Total industry	1,175	(2,217)	345	(2,748)	(1,248)	(3,225)	(3,017)	(3,008)

Sources: American Paper Institute, Dept. of Commerce.

higher domestic output. Paperboard imports, on the other hand, spurted up 56% to 533,000 tons in 1989.

Woodpulp imports dropped 0.7% to 5.0 million tons. While shipments from Canada to the U.S. increased slightly, imports from overseas dropped quite a bit. Canada remains the largest U.S. supplier by a wide margin, supplying 86% of pulp imports, 96% of newsprint, and 71% of uncoated groundwood papers.

HISTORICAL U.S. PAPER AND PAPERBOARD PRODUCTION, IMPORTS, EXPORTS, AND APPARENT CONSUMPTION, 1950-90

Year	Production[1] (000 tons)	Imports[1] (000 tons)	Exports[1] (000 tons)	Apparent consumption[2] (000 tons)	Real GNP (billion 1982 $)	Ratio consumption to real GNP (000 tons/ billion $)	Population (million)	Per capita consumption (lb/capita)
1990	78,748	12,586	5,739	85,595	4,157.0	20.59	248.7	688.3
1989	76,646	12,910	6,263	83,293	4,144.0	20.10	248.2	671.2
1988	76,466	12,788	5,559	83,695	4,024.0	20.80	245.8	681.0
1987	74,318	12,528	5,197	81,649	3,854.0	21.19	243.4	670.9
1986	70,875	11,597	4,593	77,879	3,718.0	20.95	241.1	646.0
1985	66,958	11,105	4,003	74,060	3,618.7	20.47	239.3	619.0
1984	68,468	10,576	4,310	74,734	3,501.4	21.34	237.0	630.7
1983	64,961	8,509	4,502	68,968	3,279.1	21.03	234.8	587.5
1982	59,296	7,603	4,187	62,712	3,166.0	19.81	232.5	539.5
1981	62,109	7,941	4,561	65,489	3,248.7	20.16	230.1	569.2
1980	61,042	8,304	5,148	64,198	3,187.2	20.14	227.8	563.6
1979	61,071	8,738	3,610	66,199	3,192.4	20.74	225.1	588.2
1978	58,571	8,781	3,301	64,051	3,115.2	20.56	222.6	575.5
1977	56,656	7,294	3,171	60,779	2,958.6	20.54	220.2	552.0
1976	54,993	7,042	3,388	58,647	2,826.7	20.75	218.0	538.0
1975	47,997	6,164	3,050	51,111	2,695.0	18.97	216.0	473.3
1974	55,756	7,970	3,720	60,006	2,729.3	21.99	213.9	561.1
1973	56,346	8,019	2,965	61,400	2,744.0	22.38	211.9	579.5
1972	53,842	7,567	3,019	58,390	2,608.5	22.38	209.9	556.4
1971	49,742	7,319	3,076	53,985	2,484.8	21.73	207.7	519.8
1970	48,719	7,057	2,780	52,996	2,416.2	21.93	205.1	516.8
1969	49,810	7,210	2,702	54,318	2,423.3	22.41	202.7	535.9
1968	47,071	6,792	2,587	51,276	2,365.6	21.68	200.7	511.0
1967	43,745	6,916	2,053	48,608	2,271.3	21.40	198.7	489.3
1966	43,904	7,327	1,903	49,328	2,208.3	22.34	196.6	501.8
1965	40,489	6,549	1,736	45,302	2,087.6	21.70	194.3	466.3
1964	38,066	6,154	1,661	42,559	1,973.3	21.57	191.9	443.6
1963	35,914	5,637	1,302	40,249	1,873.3	21.49	189.2	425.5
1962	34,407	5,719	1,154	38,972	1,799.4	21.66	186.5	417.9
1961	32,548	5,663	1,175	37,036	1,708.7	21.67	183.7	403.2
1960	31,221	5,610	990	35,841	1,665.2	21.52	180.7	396.7
1955	26,772	5,313	805	31,280	1,485.2	21.06	165.9	377.1
1950	21,563	4,973	337	26,199	1,210.3	21.65	152.3	344.0

1. Excludes wet machine board, construction paper and board, and hard pressed board.
2. Apparent consumption (new supply) = production + imports - exports.
Sources: American Paper Institute, Dept. of Commerce.

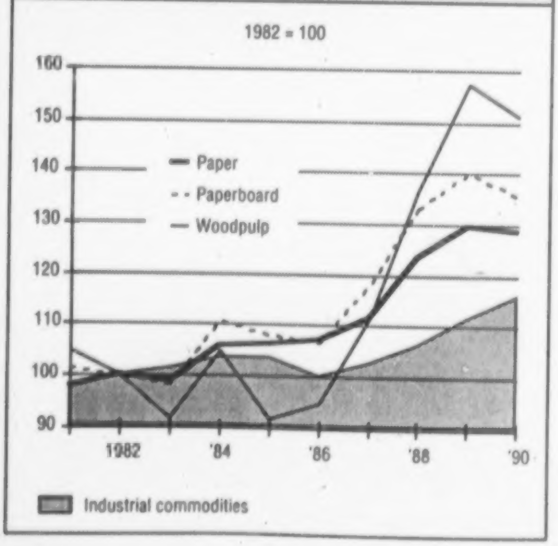
United States:

PRICES

Paper, paperboard, and converted products prices tend to decline in recessions and to rise strongly in economic recoveries. Fiber prices are even more volatile, with wastepaper often leading economic cycles and woodpulp lagging them.

Pulp and paper prices rose sluggishly during the first half of the 1980s as a result of back-to-back recessions early in the decade and the U.S. dollar's strength in 1984 and 1985. The strong dollar attracted more paper imports into U.S. markets and made it increasingly difficult for U.S. and Canadian mills to export market pulp and paperboard. The dollar's impact on pulp, paper, and board prices was as severe as any recession. In 1985, prices for paper rose only 0.2% from the previous year, according to the Dept. of Commerce's Bureau of Labor Statistics (BLS). Paperboard prices declined 4.8%, and woodpulp prices plunged 12.6%.

PAPER INDUSTRY PRICE INDEXES vs ALL INDUSTRIAL COMMODITIES



The subsequent slide in the dollar's value between 1986 and 1989 had exactly the opposite effect. The woodpulp price index shot up 20.0% between January 1986 and January 1987, followed by a further 14.3% boost between January 1987 and January 1988. Over the two-year period, paperboard prices jumped by more than 17%, while paper prices rose 12%.

New records were posted for several grades in 1987, and these were exceeded again in 1988 as demand strengthened and the dollar drifted downward. In 1987, the woodpulp index rose 17.7%, wastepaper climbed 27.7%, paperboard prices rose 10.8%, and paper grades posted a 4.2% increase. In 1988, the woodpulp index jumped 22.6%, while wastepaper inched up another 1.2%. Paperboard prices for the year were up 12.8%, and paper grades posted a 10.5% advance. In 1989, the dollar gained strength but then receded, and it continued to weaken in 1990. Woodpulp prices rose 15.2% in 1989, and both paper grades and paperboard went up 5.2%. Wastepaper prices, on the other hand, dropped off 14.4%.

Prices began to fall across the board in 1990 as the economy drifted into recession. The BLS paper index was off 0.6%, while paperboard registered a 3.1% decline and pulp prices fell 4.0%. Wastepaper took another dive, falling 11.6% on top of the double-digit drop of 1989.

The index for pulp, paper, and converted products grew slightly more than the overall producer price index in the eighties. Prices rose 5.2%/year on average for pulp, paper, and converted products vs 4.1%/year for all industrial commodities. Over the long term, however, paper industry prices have kept closer pace with the overall index, rising an average of 6.4%/year from 1970 through 1990 vs 6.3%/year for all industrial commodities.

PULP

Pulp prices are highly cyclical and tend to lag fluctuations in the world economy by as much as two years. One reason is that integrated producers are usually net buyers of pulp during strong markets but net sellers during times of weakness, causing sharp swings in supply and demand. Other factors include producer inventory levels, operating rates, and changes in average manufacturing costs. Historically, pulp prices have risen when the ratio of shipments to capacity reaches 87% to 88% and when North American and Scandinavian producer inventories have dropped to about 1.2 million metric tons. Exchange-rate fluctuations have also had an impact on pulp prices, which are quoted mainly in U.S. dollars.

Pulp prices did not fare well for the first half of the 1980s. The BLS index for woodpulp climbed just 4.5%/year during the 1980-87 period, far below the 14.0% annual growth of the 1970s. The picture improved with significant jumps of 17.7% and 22.6% in 1987 and 1988, respectively, and in 1989 pulp tabs grew another 15.2%. These hikes brought the average annual rate for the 1980s to 7.3%.

Following a decade of stability during the 1960s, pulp pricing changed drastically in the 1970s as a result of growing market tightness and a sharp escalation in production costs—particularly for energy and wood—in the 1973-74 and 1978-80 periods. In the 1978 downturn, the list price for benchmark northern bleached softwood kraft (NBSK) reached a low of $330/metric ton (delivered in the U.S.). It then rose for eight consecutive quarters, hitting $530/ton in 1980. This represented a 61% rise from the 1978 trough.

Subsequent attempts to raise prices proved unsuccessful, however. The official $545/metric ton (c.i.f., northern Europe) list price that had been in effect for two years broke in the second quarter of 1982 and plummeted to $400 to $410/ton by first-quarter 1983. This 26% decline was even worse than the 1977-78 drop. Exchange rates played a major role in the decline, as the strong dollar undermined pulp prices by giving Scandinavian and nontraditional producers a cost advantage, allowing them to cut prices to add market share. At the same time, the strong dollar made pulp more expensive for buyers with weak currencies, who became more resistant to increases. While the U.S. dollar price dropped 26% from 1980 to 1982, the price of pulp in pounds sterling, lire, and francs actually rose about 8%, and the deutsche mark price declined by 11%.

PRICE INDEXES FOR U.S. PULP, PAPER, AND PRODUCTS VS ALL INDUSTRIAL COMMODITIES

(1982 = 100)

Year	Industrial commodities	Pulp, paper, and products*	Woodpulp	Wastepaper	Paper	Paper-board	Converted products
1990	115.8	132.9	151.2	138.9	128.8	135.7	135.1
% change	3.8%	0.4%	-4.0%	-11.6%	-0.6%	-3.1%	2.6%
1989	111.6	132.4	157.5	157.1	129.6	140.1	131.7
% change	5.0%	6.1%	15.2%	-14.4%	5.2%	5.2%	7.1%
1988	106.3	124.8	136.7	183.6	123.2	133.2	123.0
% change	3.6%	9.2%	22.6%	1.2%	10.5%	12.8%	7.2%
1987	102.6	114.3	111.5	181.4	111.5	118.1	114.7
1986	100.0	107.6	94.7	142.6	107.0	106.6	109.4
1985	103.7	106.9	91.4	122.9	106.0	107.7	108.9
1984	103.3	107.3	104.8	198.2	105.8	110.4	106.4
1983	101.1	99.3	91.5	115.0	98.5	98.4	100.4
1982	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1981	97.4	99.1	104.8	145.0	97.7	101.2	97.9
1980	88.0	91.7	100.3	172.2	89.7	92.0	90.2
1979	75.7	80.6	82.9	170.5	80.2	79.3	79.4
1978	67.0	71.6	70.3	157.8	72.0	70.5	70.5
1977	62.5	68.6	74.2	154.6	67.8	69.1	66.8
1976	58.4	66.2	75.5	152.6	63.7	69.1	64.3
1975	54.9	62.9	74.8	90.9	60.4	66.8	61.2
1974	49.2	55.9	57.5	219.2	51.9	59.7	54.8
1973	40.3	44.8	33.8	162.9	42.4	45.2	46.0
1972	37.8	41.6	29.4	110.3	40.6	41.4	43.0
1971	36.5	40.4	29.6	92.5	39.9	40.2	41.5
1970	35.2	39.7	28.9	103.2	38.8	39.7	40.8
Average annual rate 1970-90	6.3%	6.4%	9.9%	6.7%	6.3%	6.6%	6.3%

*Excludes construction grades.
Source: Bureau of Labor Statistics.

Pulp prices firmed only slightly in 1983, but a labor dispute in British Columbia sparked a recovery to $540/metric ton for NBSK in Europe during the first half of 1984. However, overproduction later in the year coupled with a large bulge of new capacity drove the price back down to a low of about $390/ton by early 1985.

Chemical paper-grade pulp prices climbed four consecutive quarters in 1986 as the U.S. dollar weakened and demand strengthened. The declining dollar reversed the cost advantage of Scandinavian producers and made price increases easy to swallow for overseas customers. NBSK prices rose to $520/metric ton during the last quarter of 1986—a 33% increase for U.S. customers but only 3% in Japan and 4% in Germany.

Producers followed up with price hikes in each quarter of 1987 and 1988 and in the first two quarters of 1989. These brought the price of NBSK in Europe to $840/metric ton by second-quarter 1989—roughly twice what it fetched in 1980. Producers managed to linger within about $10 of that price level through mid-1990. But the industry's united front finally cracked under pressure from significantly cheaper southern pulp, and in July 1990, some manufacturers dropped NBSK to $800/metric ton in most major world markets. Inventories jumped to their highest levels since 1985, and producers responded to heavy pressure from customers with a reduction to $750/metric ton in November 1990. Southern pine pulp remained stable at about the $650/metric ton mark.

Nineteen ninety-one started out as a terrible year for pulp, as market conditions continued to erode and prices plummeted sharply in January. Oversupply and currency fluctuations confused the market, and Canadian producers dropped the price of NBSK in Europe in two steps to about $600/metric ton by the end of the first half. A further decline to $575 in the U.S. and $560 in Europe tested the bottom of the market in June, but heavy inventories built up by Canadian producers in anticipation of a possible strike in British Columbia caused a collapse to $520 and below in September.

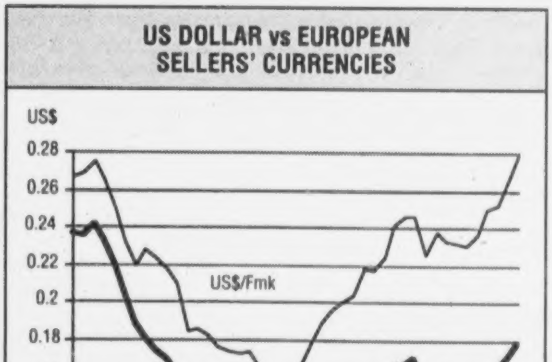
PAPER

Paper weathered the last recession better than other industry products, but prices have suffered in recent years from overcapacity in key printing/writing grades. The BLS price index for paper grades rose an average of 5.0%/year during the 1980s, compared with 8.6% annual growth in the 1970s.

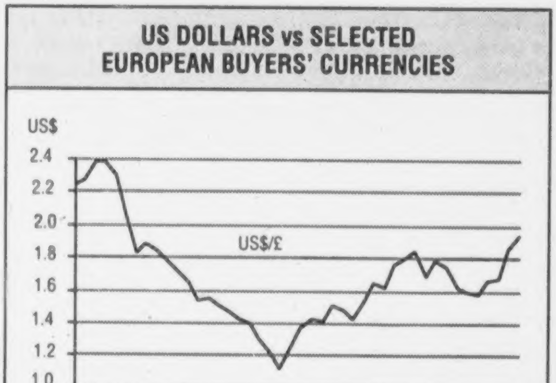
Newsprint. In October 1982, newsprint prices fell for the first time since the Great Depression, dropping from the $500/metric ton list price established in the U.S. East market in mid-1981 to $468/ton. Overcapacity forced the drop-off, while competition from other publications grades (also selling for less because of overcapacity) made already-soft markets worse. The economic recovery boosted consumption, allowing producers to push the list price back up to $500/ton in mid-1983, but transaction prices did not firm to that level until the ten-week British Columbian shutdown in first-quarter 1984.

Another price hike later in the year brought newsprint to a list of $535/metric ton, but slower growth and publisher inventory building combined to thwart an attempted increase in January 1985. Mills tried to raise prices six more times in 1985, but all of these attempts failed. Discounting increased as markets remained soft and as imports of cheap offshore newsprint picked up.

Gradually improving demand helped markets firm up in 1986, and producers were finally able to push through a price hike in October to a list of $570/metric ton, although



US DOLLAR vs EUROPEAN SELLERS' CURRENCIES



US DOLLARS vs SELECTED EUROPEAN BUYERS' CURRENCIES

SELECTED U.S. PULP, PAPER, AND CONVERTED PRODUCT PRICES

	$/short ton domestic market—unless otherwise indicated					Percentage change from year earlier			
	4th Q 1990	4th Q 1989	4th Q 1988	4th Q 1987	4th Q 1986	4th Q 1990	4th Q 1989	4th Q 1988	4th Q 1987
PULP ($/metric ton)									
Bleached softwood kraft—northern	$750*	$830	$760	$610	$480/520	-9.6%	9.2%	24.6%	22.0%
Bleached softwood kraft—southern	600/620*	800	735/740	585	490	-23.8	8.4	26.1	19.4
Bleached hardwood kraft—southern	480/490*	735	685/695	565	460	-34.0	6.5	22.1	22.8
PAPER									
Newsprint (30-lb East)	(565)*	(535-540)*	(544)*	(517)	454/499*	5.6	-1.1	5.2	8.5
Directory (22.5-lb white)	(800)/850*	(730)/780	850	720	670	2.6	-11.2	18.1	7.5
Coated publication paper									
No. 1 (+70-lb sheets)	1,610/1640*	1,610/1640*	1,560/1,600	1,440/1,460	1,375*	n.c.	2.8	9.0	5.5
No. 5 (34-lb rolls)	(940)/990	(960)/990	990/1,000	890	860*	-1.0	-2.0	11.8	3.5
Uncoated free-sheet									
Book paper (No. 3 offset, +45-lb sheets)	(940)/1,020	(940)/1,020	1,020	850	850	n.c.	-3.9	20.0	n.c.
No. 1 (watermarked, +20-lb sheets)	1,090/1,100	1,090/1,100	1,090/1,100	960	985	n.c.	n.c.	14.1	-2.5
Forms bond (15-lb rolls)	(890)/930	(800-860)/910	(880)/910	760	720	6.0	-2.8	17.8	5.6
Tissue (BLS index)	136.5	130.8	117.1	114.3	109.7	n.c.	11.7	2.4	4.2
Unbleached kraft shipping sack (+50 lb)	580/590	550/560	510/520	480/490	(420/430)	5.4	7.8	6.2	14.1
PAPERBOARD									
Unbleached kraft linerboard (42-lb East)	(360/370)*	410*	410	380	320	-8.8	n.c.	7.9	18.8
Semichemical medium (26-lb East)	(320)*	(360/370)	(390)/400	350/360	290/300	-9.9	-7.6	11.3	20.3
Folding boxboard									
Clay-coated recycled (20-pt rolls)	540/580	480/510	440/460	390/430	380/420	14.5	10.0	9.8	2.5
Solid bleached sulfate (15 pt, C1S, 80 brite, rolls)	830/840	830/840	720/740	625/660	570/625	n.c.	14.4	13.6	7.5
CONSTRUCTION GRADES									
Building paper and board (BLS index)	116.4	116.8	112.8	113.6	109.9	-0.3	3.5	-0.7	3.0
CONVERTED PRODUCTS									
FBA corrugated price index (1967 = 100)	274.0	282.4	283.6	267.4	236.0	-3.0	-0.4	6.1	13.3

*Discounting below list prices.
( ) = Estimated transaction prices where most volume is moving significantly below list.
n.c. = No change.
Sources: *Pulp & Paper Week*, Bureau of Labor Statistics, Fibre Box Assn.

the increase was not implemented fully until early 1987. Markets continued to strengthen throughout 1987, and producers were able to increase prices on July 1 by $40 to $610/ton. This was followed on Jan. 1, 1988, by another hike of $40 to $650/ton.

Transaction prices continued to be significantly below list during this time, ranging between $570 and $610/metric ton at the beginning of 1988. This proved to be the peak of the latest cycle for newsprint producers, who saw market prices erode in 1988 to an average transaction level of $600/ton, followed by an additional $30/ton drop in first-half 1989 due to sluggish demand and to anticipated capacity additions through 1990. By late 1989, average transaction prices for newsprint delivered to U.S. East markets had dropped to $535/metric ton, compared with a $650 list. In the West, prices averaged $540/metric ton in the new year.

Shrinking inventories, the threat of possible strikes in Canada, downtime, delays in new machine startups, and better European demand then firmed the market to such an extent that producers managed to push through a June 1990 price hike of $35/metric ton in the East to $685 and a rise of $31.50 in the West to $630. Transaction prices in both regions averaged $570/metric ton. Despite weak demand, in October, producers announced another increase of $35/metric ton for Jan. 1, 1991, aided by strikes in eastern Canada that curtailed production.

The increase began to falter almost immediately, however, in the face of projected flat consumption, rising capacity, and pressure from publishers. Buyers and sellers wrangled over the increase throughout the first quarter, making transaction prices difficult to pin down. The increase finally collapsed with a rollback to the old list price effective Apr. 1, while transaction prices sunk even lower. The prospect of continued oversupply and faltering ad levels left little room to hope for relief in 1991, and the market continued to unravel through the third quarter and into the fourth.

Coated paper. Heavy demand kept the coated groundwood industry running virtually flat out in the late 1970s, allowing a steady series of price increases after the 1974-75 recession. However, a heavy influx of new capacity and lower demand caused prices to flatten in 1981 and 1982, forcing a price rollback in early 1983. Demand quickly outpaced new capacity as the recovery picked up steam, allowing producers to restore prices and push through two increases in 1984. Demand for coated free-sheet was almost as strong, and mills were able to raise prices in fourth-quarter 1983, in January 1984, and in second-quarter 1984.

Coated groundwood producers raised prices again in early 1985, but fewer orders and import pressure sent prices back to late-1984 levels by early 1986. Overcapacity struck both free-sheet and groundwood grades later that year, although strong demand growth helped cushion the effects, especially for premium grades. By early 1987, both sectors were forced to roll back prices.

That distressing market situation turned around quickly at the end of the second quarter, helped by the conversion of some groundwood tonnage to free-sheet and by the temporary production of uncoated papers by a few producers. A price increase of $50 to $70/short ton was implemented in July for coated groundwood grades, and demand continued to soar through the end of 1987. That strength continued in 1988, with prices moving up 6% for No. 4 coated (50 lb, in rolls) and nearly 20% for No. 1 coated (70 lb).

Discounting crept into the picture by early 1989, however. A July 1 hike that would have boosted list levels by an average of 5% had to be rescinded. The weak market kept pricing competitive throughout the year and led to delays of new coated groundwood machines. While the fourth quarter was somewhat more upbeat, this did not carry through into 1990. Discounts early in the year on coated groundwood grades were around 4% to 6%, and No. 3 (60 lb) was at $1,120 to $1,140. By mid-year, manufacturers had decided not to try a price hike in the face of weak demand from the advertising market and new coated free-sheet capacity. In July, discounting on coated groundwood continued at a routine $40 to $60/ton, as fears of a recession and slower-than-expected orders kept pricing competitive. Transaction prices firmed up somewhat in the fall, and both coated groundwood and free-sheet producers finished the year on a positive note.

The uncertain economic outlook, exacerbated by the Gulf War, a postal rate increase, and overcapacity, began to erode coated paper transaction prices early in 1991. At least two top free-sheet producers took market-related downtime in the first quarter, and the weak summer period saw buyers shopping for deals as good as $200/ton off list prices. The situation improved with an uptick in fall catalog demand, but prices continued about $100 off list and observers suggested that a price increase was not likely until 1992.

In January 1991, the American Paper Institute charged nine European countries with dumping coated groundwood in the U.S. at 28% to 88% below fair market value. The International Trade Commission affirmed the charge in February, sending the issue to the Commerce Dept. for possible action. Duties were imposed on producers from five countries in June as part of a preliminary determination.

Uncoated free-sheet. Uncoated free-sheet prices came under heavy pressure during the 1980-82 recessions, with deep cuts in prices for all but the premium grades. As with coated papers, however, the booming recovery allowed producers to regain lost ground. Prices went up in the last quarter of 1983 and again in the following quarter.

Cheap imports and a spurt of new capacity toward the end of the year undercut prices during 1984. By the end of the year, 50-lb offset was down as low as $560/short ton, where it remained until prices in general began to improve in mid-1985. As 1985 progressed, prices firmed across the spectrum of uncoated free-sheet, and in April and July of 1986, producers raised them. Demand was strong enough to support the price increases despite overcapacity caused by completion of several major expansion projects.

In first-half 1987, that new capacity came back to haunt producers, as prices plummeted in the face of weakened demand. An attempted price hike failed at the end of the first quarter, sending prices back to late-1986 levels with sales typically about $80/short ton below list. Overcapacity and competitive price cutting delayed another increase until Sept. 1, by which time markets had tightened considerably, thanks in part to labor problems. Throughout most of 1988, mills were able to pass along one or more price increases. For example, 50-lb offset (rolls) shot up by 17% between Jan. 1, 1988, and a year later; however, the $900/ton list stagnated during the first six months of 1988 while discounting escalated to as much as $160/ton. By mid-1989, it was apparent that the market was slowing for virtually all uncoated free-sheet sectors. Even grades previously on allocation, such as cut-size repro, were loosening up. By July, prices were off as much as 20%, reflecting slowing demand, new capacity, and inventory work-off.

Producers raised prices early in 1989, although transaction prices remained below the highs of 1987 and 1988. Forms bond manufacturers tried to raise prices $40/ton in an attempt to bring transaction prices closer to list prices. On 15-lb forms, for example, the transaction price was about $860/ton before the hike, compared with a $910 list. Cut-size reprographic and offset producers followed suit in April. By mid-year 1990, cut-size prices stood at $840 to $860/ton, and offset in the Southeast ranged from $850 list down to $800 with discounts. Most major mills announced a $40/ton increase on reprographic papers for Sept. 1 in response to tight markets. A $40 to $50/ton hike on offset papers was delayed until Oct. 1.

The normal seasonal slowdown arrived at year-end 1990 with some additional concerns about weakness in the general economy and the prospect of large capacity increases slated for the coming year. Mills began to cut transaction prices on commodity offset and cut-size grades, and the weakness spread to other grades during the first quarter of 1991. Discounts of as much as 15% to 20% began to appear as markets softened further and new capacity started up, leading some producers to take downtime. Prices for 15-lb forms bond dropped to $680/ton, compared with the supposed list of $930, and the quarterly government bid for cut-size fell to $760/ton.

Prices stabilized in early summer, and major producers pushed through increases of $40/ton on cut-size and $60 to $80/ton on offset in July and August. A bold move by Champion International Corp. to tack on an additional $80/ton increase in September was joined by other papermakers, with apparent success, leading the mills to announce yet another $40/ton increase for October or November.

Brown paper. Unbleached kraft paper has been the weakest segment in recent years, particularly the heavier-weight grades, which are subject to competitive pressure from swing linerboard machines producing kraft papers during slow periods. Prices for 70-lb grocery sack paper fell from a prerecession peak of about $310/short ton to a discounted $240/ton in late 1982. Multiwall kraft sack paper also suffered during the downturn due to weakness in key markets, such as construction and agriculture. Prices picked up along with the economy in 1983, as swing machines returned to linerboard production and as inventories dropped to normal levels.

With mills running full, producers were able to push through sharp run-ups in some grades. Grocery sack prices surpassed prerecession levels in early 1984, but another increase to bring prices into parity with lightweight linerboard by early summer never fully took effect. A $30/short ton first-quarter increase for multiwall sack paper prices also failed to take hold, as agricultural and construction markets remained sluggish.

Grocery bag and sack paper prices began to deteriorate in late 1984 as the linerboard market softened, and multiwall shipping sack paper prices also weakened further. By spring 1985, renewed swing production on linerboard machines had pushed the price of 70-lb grocery sack paper down to $260/short ton or less. By summer, some multiwall paper was discounted to $360/ton and lower.

Closure of several kraft paper machines tightened the supply/demand balance beginning in mid-1985, and producers responded with a steady stream of increases on grocery bag and sack grades. As demand stayed strong, loss of market share to plastics was the only constraint on prices. Grocery bag and sack paper prices rose in September 1985, and producers pushed through successive increases in January, April, and October 1986 as well as in February 1987. Multiwall sack paper prices also climbed, with increases during the first and third quarters of 1986 and the first quarter of 1987.

The February 1987 increases brought 70-lb prices to about $400/short ton (the same as lightweight linerboard); prices for 50-lb multiwall paper rose to $450 to $460/ton. Markets stayed tight into 1987, and kraft paper producers successfully implemented a $30/ton price increase for most grades in September, again on the heels of a linerboard increase. The increase raised 70-lb grocery sack paper to $425 to $435/ton; 50-lb multiwall rose to $480 to $490/ton.

A year later, prices climbed an additional 6% to 7% or more, with 70-lb unbleached kraft paper selling for $455 to $465/short ton and 50-lb shipping sack selling for $510 to $520/ton by Oct. 1, 1988. Another hike was implemented in first-quarter 1989, raising prices about $40/ton across the board, and prices remained fairly stable through the rest of the year.

Early in 1990, grocery sack was selling as low as $430/ton for 70 lb on the West Coast but at $495 and above in the East. Multiwall paper was at $530 to $550 for 50 lb. Weaker demand and increased competition from Pacific Rim producers prompted Canadian manufacturers to ship more to the U.S. But maintenance shutdowns and increased swing-machine production of linerboard helped prices stay steady through mid-1990. Major producers Stone Container Corp. and Simpson Paper Co. announced hikes of $30/ton for September, leading other producers to announce similar increases for the fall. Price competition in the West remained fierce, however.

By early 1991, producers were still having difficulty implementing the $30/ton increase. Transaction prices for 50-lb multiwall generally remained at the $550 to $560/ton level. Demand rose modestly in the first quarter, but producers were pessimistic about the market because of sharp discounting for heavyweight grocery sack paper, despite firm prices for most lightweight grades. Recycled bag shipments rose sharply to meet new demand for "green" products. Prices for multiwall papers remained largely unchanged through mid-1991 at about $550/ton, despite a slowdown in industrial demand caused by the recession. The price of 70-lb grocery bag paper stabilized at the $425 to $435/ton level, down from $495/ton in 1990.

PAPERBOARD

Paperboard prices climbed an average of 6.1%/year during the 1980s, down from an 8.4%/year rate in the previous decade. Hurt by the strong dollar, prices on average declined 4.8% in 1985 and another 1.2% in 1986. Prices bounced back in 1987, however, rising 10.8% due to strong domestic demand and a weaker dollar. This was followed by gains of 12.8% in 1988 and 5.2% the following year, preceding the recession-induced decline of 3.1% in 1990.

Containerboard. Both linerboard and corrugating medium suffered sharp drops during the recessions of the early 1980s, with 42-lb linerboard prices falling from $300/short ton in early 1981 to $250/ton and lower by late 1982. Corrugating medium took a similar plunge. Prices began climbing again in 1983, but producers were unable to regain old levels until a February 1984 hike to $320/ton.

An increase to $350/short ton attempted in fall 1984 only partly took hold because of increasing pressure on the market from the strong U.S. dollar. Containerboard prices began to erode in early 1985, and by summer, linerboard was down to $250 to $260/ton, where it stayed for the rest of the year.

Markets tightened in late 1985 due to healthy box demand, a surge in export shipments, and production curtailments. Linerboard prices made a strong recovery in 1986, with the base price of 42-lb board rising from $260/short ton and below in the first quarter to $320/ton by the third quarter. Strong export demand, aided by the dollar's decline, was a big factor in the upturn. Producers easily pushed through a $30/ton hike in January 1987, returning list levels to their peak of fall 1984. Two other increases later in 1987 raised 42-lb linerboard to $410/ton before zoned discounts. However, a price hike of $40/ton in first-quarter 1989 had to be rescinded due to weakening demand as the economy stagnated and box makers resisted the increase. The linerboard market was balanced through mid-year, although discounts of $10 to $20 were fairly common in the Northeast.

In spite of strong exports, 42-lb linerboard tabs dropped to $380/ton in first-quarter 1990 in the East. Expansion downtime helped to stabilize the grade at that level into the second quarter, but by mid-year the price was off another $10 to $20.

Prices for semichemical medium have generally followed the pattern for linerboard, although the differential between both has been a wide $30 to $40/short ton since at least 1988. In second-quarter 1989, 26-lb semichemical medium sold for $380 to $390/ton. Part of the problem was increased competition from Canadian suppliers as a result of the Free Trade Agreement lowering tariffs, plus increased availability of recycled board at prices of about $350/ton.

By fourth-quarter 1989, semichemical corrugating medium was selling for about $350/ton in the Northeast, $360 to $370 in the Midwest, and $10 higher than that on the West Coast. Those tabs slipped to $330 to $350 by second-quarter 1990 in the Northeast and to $310 by the summer, although West Coast prices were $340 to $360. Recycled medium dropped to $290 to $300—close to break-even for some producers.

In September, major players International Paper Co. and Stone Container announced Oct. 1 hikes to restore the list price for 42-lb linerboard to $410/short ton in the East and $420 in the West. Stone also raised the price of 26-lb corrugating medium in the East to $350 for semichemical and $340 for recycled. Other producers quickly joined the move, but concerns about the weak economy prevailed, and by the end-of-year slowdown, the attempt had failed.

Prices for linerboard and medium began to erode again in January, as transaction prices dipped to the $350/ton range for liner and $300 for medium. Demand from box makers slowed, leading to more price cuts for containerboard producers. By May, prices had bottomed out at $330/ton in the Northeast for linerboard and $280 to $290 for semichemical medium. Talk spread about a possible fall increase, and Stone led the way with an increase to $380 for liner, $330 for semichemical medium, and $320 for recycled medium slated for Aug. 1. Other producers jumped aboard, and the $30/ton increases were pushed through in September.

In Europe, U.S. producers successfully pushed through a $35/metric ton increase on heavyweight board in fall 1986, raising prices to $405/ton before duties. Similar increases were successful in March and August 1987. The $40/ton increase in August brought heavyweight linerboard in Europe to $480/ton c.i.f. in most markets, while the list for lightweight linerboard in Southeast Asia rose to $515 to $530/ton, depending on the country. Gradual weakening in the U.S. domestic market in 1988 caused transaction prices offshore to drop to levels as low as $420 to $430/ton in some markets. By mid-1989, linerboard prices in many export markets were $20 to $30 below domestic price levels and were almost twice that one quarter later as a result of too much U.S. capacity. Exports dropped off as a result. Average prices for exports from southern mills were around $330 to $350/ton f.a.s. in November as a result of apparently unfounded expectations of a weaker market. U.S. export prices in northern Europe for heavyweight linerboard were around $440 to $460/ton c.i.f. early in 1990. And first-quarter tabs for linerboard in Southeast Asia stabilized at about $470 to $500 after dropping $30/ton in the previous quarter. These levels held in Europe through mid-1990, and Southeast Asian markets firmed somewhat.

Encouraged by unexpectedly strong demand during the summer, U.S. linerboard producers announced a price increase for export customers of $30/metric ton to take effect Sept. 1. The strong demand led to general acceptance.

Boxboard. Although more recession-proof than other grades because of various end uses in food packaging, solid bleached folding boxboard prices fell in 1982, in part because of competition from clay-coated recycled boxboard mills benefiting from the sharp decline in wastepaper prices. In 1983, some producers tried to return to the $625/short ton list but failed. Markets moved up sharply during the last half of 1984, only to erode in 1985. On the recycled side, chipboard prices remained relatively firm during the 1984-85 downturn, but clay-coated board prices were down to the $300/ton range in some spot sales by 1985.

Bleached board prices began to firm up in first-quarter 1986. Producers raised lists about $30/short ton and began to cut back on discounts. A second round of hikes was successful in the third quarter, but a third attempt at the end of the year failed to gain support. After trying and generally failing to raise prices all year, recycled producers got some relief from high wastepaper prices, with a fourth-quarter increase in all areas of the country except the West Coast.

After some initial difficulty, producers raised bleached board prices again in spring 1987, bringing folding carton stock prices up $30/short ton to a new list of about $645/ton. West Coast recycled board producers also pushed through a price hike, their first in over two years. Bleached board producers took advantage of a pickup in business in late summer to announce another increase of about $35/ton effective in the fall. At the same time, recycled boxboard producers in the Midwest implemented price hikes, raising transaction prices to $390 to $430/ton for most business.

In 1988, bleached board producers increased prices by $40/short ton in April and by $55/ton in September, raising the price of 15-pt board to $730/ton by year end. This was followed by two $50/ton hikes in January and August 1989, which raised the list to $830/ton.

Recycled board producers were equally aggressive in 1988, raising prices of folding carton stock three times. Prices for 20-pt clay-coated board increased about $100/short ton to $500/ton by year end. The momentum did not carry over into 1989, however. But as 1990 approached, producers announced a rise in clay-coated recycled folding boxboard of $35/ton.

A slowing economy and customer inventory reductions caused manufacturers to scale back bleached folding carton stock production in first-quarter 1990. Prices of $830 to $840/ton for 15-pt clay-coated folding carton grades were temporarily discounted $30 in the spring, although many bounced back by mid-year, when the inventory work-down appeared to be complete. Strong demand from consumer goods manufacturers firmed recycled prices during the same period, leading to a price increase of $35 to $40/ton at the beginning of the fourth quarter. Through the end of the year, prices remained stable for bleached paperboard and coated kraft board producers.

In 1991, Federal Paper Board Co. Inc. attempted to raise bleached packaging grades $40/ton on Apr. 1 but had to cancel in the face of stiff resistance. A later try by a larger group of producers resulted in a successful $40/ton increase at mid-year. The move raised 18- to 32-pt premium clay-coated grades to $870 to $880/ton.

CONVERTED PRODUCTS

Converted products prices have been more stable than primary grades, holding up better during the early-1980s recession but missing out on the strong recovery afterward. Prices rose an average of 5.3%/year during the 1980s, down from 7.8%/year in the 1970s. That is somewhat better than the performance of paper although not as good as paperboard, indicating that some converters have been unable to pass entirely on raw materials price increases and maintain profit margins over the long term.

Converted products price indexes outperformed paper and board in the recession years, rising 2.1% in 1982 and 0.4% in 1983. However, converters did not keep pace with increases on paper and paperboard in 1984, as converted prices climbed only 6.0%, compared with 15.1% for paperboard and 7.4% for paper. Converters again kept pace with their suppliers during the sluggish 1985-86 period, but since then, prices have fluctuated for converted products in comparison with paper and board. The converted products price index for 1988 was up only 7.2% from the previous year, compared with a 12.8% increase for paperboard, suggesting some renewed and substantial pressure on converters' profit margins. The following year they recovered some of that by raising prices 7.1%, vs paper and board producers' more modest 5.2% hike. Converters eked out a 2.6% increase in 1990, while paper and paperboard prices were headed downward.

Corrugated box prices tend to follow domestic swings in containerboard prices, as converters try to pass on higher input costs. Containerboard accounts for about 50% to 55% of the cost of producing a corrugated box. Converter profit margins fattened in 1985, when containerboard prices fell nearly 30% and box prices fell only about 12%. Since then, however, box prices have failed to match the steep run-up in containerboard prices. After several failed attempts, converters pushed through an 8% increase in third-quarter 1986. After the January 1987 containerboard price hike, integrated box makers got another 10% increase in box prices in the spring. This returned box prices to near their previous historic high. Under pressure from higher containerboard prices, box makers were fairly successful in pushing through an 8% increase in September. Corrugated box end users saw their box costs rise nearly 9% in 1988 after an 11.5% rise in 1987. In second-quarter 1989, some producers attempted to push through price hikes of 8% to 10% on corrugated boxes; however, with linerboard prices faltering, these attempts were not fail-safe. And, in fact, the index for box prices sank 1.5% by year end. Demand stayed fairly level over the first half of 1990, and new corrugating capacity came onstream, pushing down box prices further and squeezing box makers' margins. Stone Container announced a 9.6% increase for October that was joined by other major producers, but the move faded because of concerns about the economy and the failure of a concurrent linerboard price hike.

After a six-month period of stability, box prices came under pressure in early 1991. By March, companies were reducing prices by 3% to 5% in a weak, confused market. Market demand began to pick up in the second quarter, however, and by summer, pressure was building for a box price increase to match a proposed increase in containerboard prices. The board price increase succeeded in September but with no resolution on how much of the increase would be passed on in higher box prices.

United States:

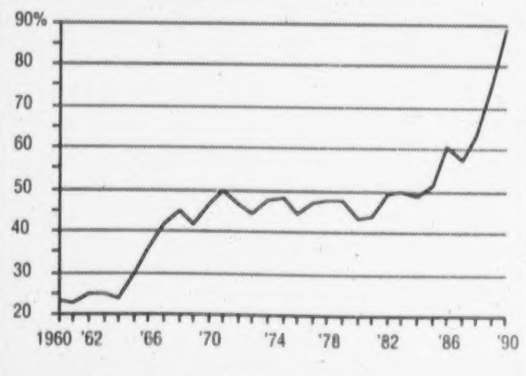
PROFITABILITY

Net profits, after having faltered in 1989, plunged in 1990. According to the Bureau of Census, the U.S. paper and allied products industry tallied 1990 net profits of $4.9 billion, down 31% vs 1989, on slightly higher sales of $115.5 billion. Relatively similar comparisons were provided by our survey of 32 companies in the industry. Our group showed sales creeping forward 3.9% to $99 billion, largely due to acquisitions by Georgia-Pacific Corp. and International Paper Co., but net income was down 36.9% to $4.1 billion; profit margins sank to 4.2% in 1990, down from 6.9% in 1989.

The principal reason for 1990's decline in profitability was the slide in paper product prices as capacity increased at a quicker rate than demand, and producers, stuck with high fixed costs, aggressively sought to market their output. The reduction in profits and margins was exacerbated by a series of major "restructuring" charges taken in late 1990. Excluding major nonrecurring items in both 1989 and 1990, net profits at the companies included in the 32-company survey fell about 30%, from roughly $6.9 billion in 1989 to $4.8 billion in 1990. Corresponding net margins were 7.2% in 1989 and 4.9% in 1990.

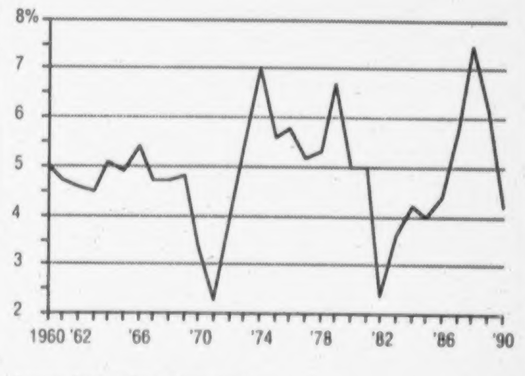
Difficult conditions are persisting in 1991 as product prices continue to head lower. A survey of 30 industry players showed net sales for the group slipped 5% and earnings tumbled almost 55% in first-half 1991. The damage from lower paper prices for commodity-oriented grades, such as uncoated free-sheet and containerboard, has been severe. Boise Cascade Corp., for instance, posted the worst performance in the group (a $49.4-million net loss), largely because of its focus on these grades, especially uncoated white papers. Indeed, operating profits for Boise's paper

DEBT TO NET WORTH, 1960-90



Source: Federal Trade Commission.

PROFIT MARGIN, 1960-90



Source: Federal Trade Commission.

and paper products group collapsed from $99 million in first-half 1990 to a $13-million deficit in first-half 1991.

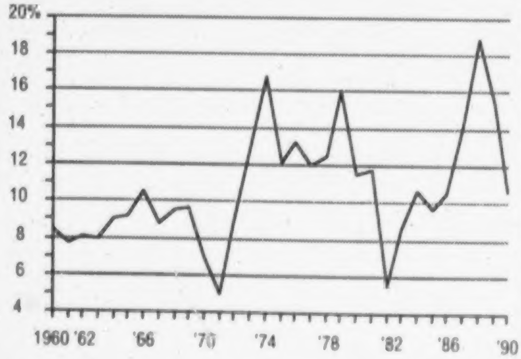
Market pulp producers are also hurting badly as average realizations for southern bleached softwood kraft had dropped to an estimated $450/ton by third-quarter 1991, almost 30% lower than year-ago pricing.

COMPANY ROUNDUP

The majors lead the way down. International Paper retained its position in 1990 as industry leader in terms of sales and profits. IP reported a 13.7% increase in sales to $13 billion, thanks largely to contributions from recent acquisitions, including, among others, Aussedat Rey, Zanders Feinpapiere AG, the Ilford Group, and Dixon Paper Co. IP's bottom line dropped 34% to $569 million, however, as the company took a fourth-quarter $137-million business improvement charge to divest certain underperforming assets. Excluding this nonrecurring (and noncash) loss, earnings were a more respectable $706 million, or an 18% decline from 1989's $864 million tally. IP CEO John A. Georges described results as "good, especially when considered in light of a domestic economy that spun into a recession as the year progressed." Georges attributed the "strong performance" to the company's 1980s program to improve product quality and services and to lower costs. Also, IP's recent acquisitions panned out favorably as increased global diversification helped buffer negative effects from the domestic downturn. International Paper's performance has continued to worsen in 1991, however. In the first half of the year, net earnings were $236 million on sales of $6.2 billion, compared with $365 million on sales of $6.4 billion in first-half 1990. CEO Georges attributed the earnings decline to weakness in product pricing, notably uncoated papers and linerboard.

At Georgia-Pacific, attention was tuned in 1990 to the company's March acquisition of Great Northern Nekoosa Corp. for about $3.7 billion. The acquisition drove 1990 sales almost 25% higher to $12.7 billion. Net interest expense also jumped, from $260 million in 1989 to $606 million in 1990, reflecting the increased debt load consequent to the GNN acquisition. However, lower prices for paper and depressed markets for wood products prevented operating earnings from rising in concert. The upshot was that earnings headed south, tallying $365 million for the year (including $30 million in net nonrecurring gains), down 45% compared with 1989. Due to weakness in most all of its markets, G-P reported a $46-million earnings deficit from "normal operations" through first-half 1991. However, thanks to a gain of $72 million in asset sales, reported net income was above water at $26 million.

RETURN ON NET WORTH, 1960-90



Source: Federal Trade Commission

Weyerhaeuser Co. also had a difficult 1990. The slumping construction industry hurt results at the company's forest products division, while weakening pulp, containerboard, and white papers markets undermined profitability for its pulp and paper operations. Net sales for the year were down 10.7%, and earnings dropped almost 35% (excluding net restructuring charges of $260 million in 1989). Moreover, the rate of earnings decline quickened in first-half 1991 as lower product prices and a high level of maintenance downtime further undermined profitability at the company's pulp and paper operations.

Containerboard blues. As the packaging industry witnessed extensive consolidation during the 1980s, some observers wondered whether or not the new industry giants would be able to exercise increased control over pricing and thereby usher in a new golden era for box makers. This has certainly not been the case in the early 1990s.

The nation's number one containerboard producer, Stone Container Corp., recorded sales of $5.8 billion, 8% above 1989's total. The sales gain was due to the inclusion of the results of newsprint-oriented Stone-Consolidated Inc., purchased in March 1989, for a full year. A full year's worth of the acquisition provided no help to the bottom line, however, as higher interest expense and lower selling prices for most of the company's principal products led to a 68% decline in earnings to $95 million. And as containerboard and pulp prices continued to fall in 1991, so did Stone's profits. The company managed to squeeze only a negligible $1.1-million gain through first-half 1991 and would have been in the red excepting a $17-million pretax gain from an involuntary conversion relating to a boiler explosion at the company's Missoula, Mont., linerboard mill. Moreover, the outlook for the remainder of the year is not bright, with Stone likely to post a loss in the third quarter.

Highly leveraged Gaylord Container Corp. has been especially hard hit by the downturn in the packaging markets. In fiscal year 1990 (ended Sept. 30), lower product prices and expansion-related downtime at the company's Bogalusa, La., and Antioch, Calif., paperboard mills as well as massive interest expense ($72.4 million) led to a $23-million deficit on sales of $718 million. Moreover, with containerboard prices staying in the doldrums in 1991, the company's woes have grown. Early in the year, Gaylord shut down two machines at Antioch's East Mill. With little likelihood of restarting the machines, Gaylord later booked

U.S. PAPER AND FOREST PRODUCTS COMPANY SALES AND EARNINGS, 1990

(million $)

Companies	Sales	% change 1990/89	Net Profit	% change 1990/89
Badger Paper[1]	$76	1.9%	$5.0	-5.5%
Boise Cascade	4,186	-3.5	75.3	-71.9
Bowater[2]	1,380	-4.8	78.4	-45.8
Champion International[3]	5,090	-1.4	223.6	-48.3
Chesapeake	841	3.4	16.7	-64.9
Consolidated Papers	949	-0.4	142.5	-15.1
Federal Paper Board[4]	1,366	4.3	118.2	-42.5
Gaylord Container (FY 9/30)	718	-3.8	-23.2	-158.9
Georgia-Pacific[5]	12,665	24.5	365.0	-44.8
P. H. Glatfelter	625	4.5	88.3	-4.9
International Paper[6]	12,960	13.7	569.0	-34.1
ITT Rayonier[7]	1,104	2.0	65.9	-48.5
James River[8]	5,416	-9.0	78.0	-64.8
Jefferson Smurfit[9]	2,911	-0.9	22.0	-38.6
Kimberly-Clark[10]	6,407	11.7	432.1	2.0
Longview Fibre (FY 10/31)	686	-1.7	61.1	-8.1
Louisiana-Pacific	1,793	-10.8	91.1	-52.7
Mead[11]	4,772	3.5	38.5	-82.2
Mosinee Paper[12]	210	-9.9	12.0	80.0
Pentair	1,176	1.1	33.0	-9.3
Pope & Talbot[13]	562	-8.4	19.8	-54.6
Potlatch	1,253	2.1	98.6	-27.9
St. Joe Paper	610	-4.0	41.3	-38.6
Scott Paper[14]	5,356	5.7	148.0	-60.6
Sonoco Products[15]	1,669	0.8	50.4	-51.4
Stone Container	5,756	8.0	95.4	-66.6
Temple-Inland[16]	1,893	-0.1	232.5	12.1
Union Camp	2,840	2.8	229.6	-23.3
Wausau (FY 8/31)[17]	340	7.2	15.9	-24.1
Westvaco (FY 10/31)	2,411	5.6	188.2	-15.6
Weyerhaeuser[18]	9,024	-10.7	393.7	15.4
Willamette Industries	1,905	0.7	129.6	-32.2
Total	98,950.6	3.9	4,135.5	-36.9

1. **Badger Paper:** 1990 results include a $1.4-million gain from a change in accounting. 2. **Bowater Inc.**: 1990 results include an extraordinary $9-million charge related to early retirement of debt. 3. **Champion International Corp.**: 1990 results include a $43-million (pretax) restructuring charge and a $39-million gain relating from resolution of issues related to St. Regis merger. 4. **Federal Paper Board Co. Inc.**: 1990 results include a $27-million (pretax) write-down of assets. 5. **Georgia-Pacific Corp.**: 1990 results include net nonrecurring gains of approximately $30 million. 6. **International Paper Co.**: 1990 results include a $137-million business improvement charge. 7. **ITT Rayonier Inc.**: 1990 results include a $43-million charge against discontinued operations. 8. **James River Corp.**: 1990 results are for fiscal year ending December 1990. 1989 results are for fiscal year ending April 1989. Also, James River's 1990 results include restructuring charges estimated at $155 million after tax. 9. **Jefferson Smurfit Corp.**: 1989 results include a $139-million pretax recapitalization expense and a $30-million after-tax extraordinary expense. 10. **Kimberly-Clark Corp.**: 1990 results include a $44-million write-down of the Spruce Falls mill. 11. **Mead Corp.**: 1989 results include a $15-million gain from the sale of Mead Release Products and a $31.5-million loss from discontinued operations. Mead's 1990 results include net nonrecurring items totaling a deficit of about $125 million. 12. **Mosinee Paper Corp.**: 1989 results include a $16.7-million (pretax) restructuring charge and a $5-million (after-tax) accounting gain. 13. **Pope & Talbot Inc.**: 1989 results include a $3.5-million net gain on the sale of a sawmill. 14. **Scott Paper Co.**: 1989 results include a $175-million gain from the sale of timberlands and a $75-million loss related to restructuring. Scott's 1990 results include $100 million in restructuring charges. 15. **Sonoco Products Co.**: 1990 results include a $55-million net restructuring charge. 16. **Temple-Inland Inc.**: sales do not include financial service revenues: $509 million in 1990 and $49 million in 1989. 17. **Wausau Paper Mills Co.**: 1990 results include life insurance proceeds of $1.9 million. 18. **Weyerhaeuser Co.**: 1989 results include a $260-million net restructuring charge.

Source: Company reports.

U.S. PAPER AND FOREST PRODUCTS COMPANY SALES AND EARNINGS, FIRST-HALF 1991

(million $)

Companies	Sales	% change 1991/90	Net Profit	% change 1991/90
Badger Paper[1]	$35.4	-8.0%	%2.4	-18.8%
Boise Cascade	1,970.6	-6.9	-49.4	-187.3
Bowater[2]	650.7	-4.4	37.0	1.6
Champion International[3]	2,343.3	-7.9	19.3	-85.5
Chesapeake	417.3	-2.1	4.9	-59.3
Consolidated Papers	450.6	-5.8	50.2	-36.0
Federal Paper Board	678.0	6.9	52.5	-28.5
Gaylord Container (FY 9/30)[4]	509.9	-1.3	-148.1	0.0
Georgia-Pacific[5]	5,759.0	-6.8	26.0	-87.5
P. H. Glatfelter	284.3	-9.9	38.1	-9.9
International Paper	6,211.0	-3.0	236.0	-35.3
James River[6]	2,338.6	-18.8	62.1	-38.8
Kimberly-Clark[7]	3,355.4	5.3	243.5	23.2
Longview Fibre (FY 10/31)	310.5	-6.0	4.7	-83.4
Louisiana-Pacific	847.4	-13.2	20.6	-72.1
Mead[8]	2,273.7	-4.0	32.1	-62.5
Mosinee Paper	95.9	-12.0	0.0	-99.2
Pentair	572.9	-1.4	16.3	28.0
Pope & Talbot[9]	262.8	-10.3	3.9	-79.9
Potlatch[10]	610.2	-5.8	21.4	-69.1
St. Joe Paper	279.2	-9.7	9.2	-59.5
Scott Paper	2,443.4	-5.9	59.8	-55.6
Sonoco Products[11]	829.9	0.7	45.2	-13.6
Stone Container[12]	2,664.0	-7.6	1.1	-98.3
Temple-Inland[13]	953.8	0.2	82.7	-35.3
Union Camp	1,452.8	2.6	71.1	-43.5
Wausau (FY 8/31)[14]	258.8	1.7	21.0	81.2
Westvaco (FY 10/31)[15]	1,131.3	-3.2	52.3	-43.4
Weyerhaeuser	4,359.3	-6.8	122.0	-50.1
Willamette Industries[16]	956.0	-0.6	17.0	-80.2
Total	45,305.9	-5.1	1,155.0	-54.7

1. **Badger Paper:** first-half 1990 net income includes a $1.4-million gain from a change in accounting for income taxes. 2. **Bowater Inc.**: first-half 1990 net income includes an extraordinary $9-million charge related to early retirement of debt. 3. **Champion International Corp.**: first-half 1990 results include provisions of $44 million in restructuring charges and a $39-million gain from resolution of issues related to St. Regis merger. 4. **Gaylord Container Corp.**: results are for nine months ending June 30. Net income for the first nine months of 1991 includes a $101.2-million asset write-down. 5. **Georgia-Pacific Corp.**: first-half 1991 net income includes net nonrecurring gains of $72 million. 6. **James River Corp.**: first-half 1990 net income includes a $24.6-million gain on the sale of its Nonwovens Div. and a $36-million asset write-off. 7. **Kimberly-Clark Corp.**: first-half 1990 net income includes a $44-million write-down of the Spruce Falls mill. 8. **Mead Corp.**: first-half 1990 net income includes $14.7 million in losses from discontinued operations. 9. **Pope & Talbot Inc.**: first-half 1990 net income include $3.4-million gain on timberland sales. 10. **Potlatch Corp.**: first-half 1991 results include $7.8-million (pretax) expense associated with special early retirement programs. 11. **Sonoco Products Co.**: first-half 1991 net income includes $4.5-million gain from sale of assets. 12. **Stone Container Corp.**: first-half 1991 results include $17-million pretax gain from involuntary conversion relating to a boiler explosion and a $6-million pretax reorganization charge. 13. **Temple Inland Inc.**: sales do not include financial services revenues, $271 million in first-half 1991 and $226 million in first-half 1990. 14. **Wausau Paper Mills Co.**: results are for nine months ending May 31. Net income for first nine months of 1990 includes $1.9 million in life insurance proceeds. 15. **Westvaco Corp.**: first half of fiscal 1991 net income includes a $15.7-million charge to cover financial aspects of Westvaco's cost-reduction programs. 16. **Willamette:** first-half 1991 net income includes a $1.9-million charge relating to closure of an Oregon plywood plant.

Source: Company reports.

a $101.2-million write-down against net income (this came on top of a $46.9-million loss from operations through the first nine months of fiscal 1991).

Temple-Inland Inc. was one of the brighter stories in 1990 as it managed to raise its bottom line 12.1% to $232.5 million. The trick here was operating gains and tax benefits from the company's expanding financial services operations, which include a number of Texas-based savings and loan institutions. In 1990, Temple-Inland's containerboard/packaging operations suffered a 27% drop in operating profits, and pretax income at $269 million was 14% shy of its year-ago counterpart. But this was more than made up at the bottom line as the company had only a 13.5% corporate rate in 1990, vs a 33.5% rate in 1989, due to tax breaks related to its S&Ls. But despite continued tax benefits and rising profits from its financial service businesses, Temple-Inland was unable to keep the momentum going forward through first-half 1991. Net income for the first six months slipped 35% to $82.7 million from the year-ago period, largely due to lower containerboard and box pricing.

U.S. PAPER AND ALLIED PRODUCTS INDUSTRY FINANCIAL PERFORMANCE, 1960-90

(million $)

					Financial ratios			
Year	Net sales	Percent change from prior year	Net profit after taxes	Percent change from prior year	Profit margins	Return on net worth	Return on total capital	Debt to net worth
1990*	$115,523	1.0%	$4,882	-31.3%	4.2%	10.6%	5.6%	88.6%
1989*	113,573	4.7	7,047	-13.4	6.2	15.4	8.8	75.7
1988*	107,221	12.0	8,081	46.3	7.5	18.8	11.5	63.3
1987*	95,576	15.7	5,520	52.1	5.8	14.1	9.0	57.2
1986*	74,844	4.8	3,280	14.3	4.4	10.5	6.5	60.6
1985*	71,465	-0.2	2,880	-4.1	4.0	9.7	6.4	51.4
1984	71,891	10.6	3,015	29.6	4.2	10.7	7.2	49.0
1983*	65,008	9.6	2,327	60.1	3.6	8.5	5.7	49.8
1982	60,293	-3.8	1,460	-53.1	2.4	5.5	3.7	49.2
1981*	62,699	11.1	3,110	11.0	5.0	11.7	8.1	44.1
1980*	56,250	7.2	2,800	-18.3	5.0	11.5	8.0	43.4
1979	55,359	13.0	3,723	43.3	6.7	16.0	10.9	47.5
1978*	48,982	8.6	2,598	11.9	5.3	12.5	8.5	47.6
1977*	45,750	6.8	2,367	-1.6	5.2	12.0	8.2	47.0
1976	39,270	22.6	2,270	26.0	5.8	13.2	9.1	44.3
1975	32,044	-2.4	1,801	-21.3	5.6	12.1	8.2	48.3
1974*	32,837	16.2	2,287	51.5	7.0	16.8	11.4	47.5
1973*	26,503	13.6	1,441	53.1	5.4	12.9	8.9	44.2
1972	23,324	4.9	941	83.8	4.0	8.9	6.0	46.8
1971*	22,224	5.5	512	-28.8	2.3	5.0	3.3	49.7
1970	21,069	2.2	719	-27.2	3.4	7.0	4.8	46.8
1969	20,607	10.0	987	11.0	4.8	9.7	6.8	41.8
1968	18,738	10.9	889	11.7	4.7	9.6	6.6	45.1
1967*	16,900	-0.7	796	-12.6	4.7	8.8	6.2	41.5
1966	17,016	4.9	911	4.8	5.4	10.5	7.7	35.6
1965*	15,217	9.8	753	15.3	4.9	9.2	7.1	30.0
1964	14,771	5.1	754	18.9	5.1	9.1	7.3	23.7
1963	14,050	2.6	634	1.0	4.5	8.0	6.4	24.9
1962	13,698	9.4	628	7.7	4.6	8.1	6.5	25.1
1961	12,525	6.5	583	-0.7	4.7	7.7	6.2	22.6
1960	11,764	-0.5	587	-5.2	5.0	8.4	6.8	23.3
Average 1960-69		5.8		5.2	4.8	8.9	6.8	31.4
Average 1970-79		9.1		19.1	5.1	11.6	7.9	47.0
Average 1980-89		7.2		12.5	4.8	11.6	7.5	54.4

*Revised—change in corporations included in industry. Percent changes for sales and profits are computed from data (not shown) consistent with previous year.

Definitions: Profit margins = after-tax net profit to net sales. Return on net worth = after-tax net profit to net worth.

Return on total capital = after-tax profit to net worth + long-term debt. Debt to net worth = long-term debt to net worth.

Sources: Federal Trade Commission, Securities & Exchange Commission, Bureau of the Census. Compiled by American Paper Institute.

Tissue makers have had mixed fortunes. Despite high marketing costs due to heated market share competition, tissue makers have been among the strongest performers in the industry. Among the chief reasons are that most major tissue producers are net purchasers of pulp (whose price has fallen rapidly since 1990) and that most have exposure to profitable foreign interests.

A standout performer in this group has been Kimberly-Clark Corp., which managed a 2.0% gain in profits to $432 million, despite a $44-million write-down of the since-divested Spruce Falls newsprint mill. Excluding the Spruce Falls nonrecurring charge, earnings were up 12.3%. K-C continued to outperform the industry in 1991. Despite exceptionally aggressive marketing in its consumer products business (with concomitant high costs), K-C took advantage of lower pulp prices to report net income of $243.5 million on sales of $3.4 billion in first-half 1991. This compares with net profits of $242 million (excluding the $44-million Spruce Falls write-down) on sales of $3.2 billion in first-half 1990.

James River Corp., on the other hand, reported earnings for the 53-week period ending December 1990 at a lowly $78 million, vs $222 million in the 52-week period ending April 1989. Results in 1990, however, include about $263 million in pretax charges relating to restructuring plans and asset write-offs as well as a $52-million pretax gain on the sale of its Nonwovens Div. Excluding these nonrecurring items, net income is estimated to have tallied $233 million in 1990, suggesting a slight improvement at ongoing operations from May to December 1990 over the same period in 1989. Results in first-half 1991 were less encouraging, however. Net income fell sharply to $22.7 million due to competitive activity in the retail premium tissue product lines, persistent softness in pricing in the commercial tissue business, and a rapid decline in uncoated free-sheet prices.

Like James River, Scott Paper Co.'s 1990 financial results were impacted by restructuring charges. Net income was down 61% to $148 million; but whereas 1989 had included net nonrecurring gains of $73 million, 1990 was plagued with a $100-million restructuring charge. Adjusted for these items, net income slipped a more modest 18%. The drop-off was due to manufacturing problems and high costs at S.D. Warren Co.'s coated paper operations. Operating profits at Scott's personal care and cleaning businesses actually edged forward 7% to $363 million in 1990. S.D. Warren has continued to be a scourge in 1991, so that despite a strong showing by Scott's international personal care and cleaning businesses, net income through the first half of the year was $59.8 million, 56% lower than 1990's first-half tally.

LOOKING AHEAD

A surge in paper and (worldwide) pulp capacity in 1991 provides a difficult backdrop for paper industry profitability in the year ahead. Moreover, through summer 1991, the general economy was still performing sluggishly, and signals were mixed regarding the timing and strength of a recovery. This combination of expanding supply and weak demand translates into declining operating rates and lower product prices for most pulp and paper grades. So although there are pockets of potential strength, such as bleached board and tissue, the overall outlook remains muted. The market pulp situation appears particularly dire due to the exceptionally large amount of new capacity having come online in North America, Chile, and Brazil. Also, corporate profits are going to be further pressured by heavy interest charges related to the high level of debt that the industry has assumed in recent years.

HISTORICAL PERFORMANCE

Earnings declined between 1980 and 1983 in the worst recession of the postwar period. Federal Trade Commission data show that U.S. paper and allied products earnings had a particularly disastrous 1982, with earnings falling 53%—more than twice the decline suffered in the 1974-75 downturn and on par with the recession of 1970-71, when profits tumbled 56% over the two-year period.

After six consecutive quarters of decline, paper industry earnings began to show faint signs of recovery in second-quarter 1983, with a *Pulp & Paper* magazine survey of 23 companies showing results 6% above year-earlier levels. Forest products companies, meanwhile, got a much-needed lift from a jump in housing starts and from higher prices for building materials. In sum, a *Pulp & Paper* survey of six leading forest products companies showed profits up 16% above 1982 levels. Although lumber prices collapsed in the third quarter due to overcapacity, paper shipments—and prices—improved steadily. And according to *P&P*'s year-end survey, paper and forest products companies posted profit increases of 34% and 90%, respectively. As the economic recovery gathered steam late in the fourth quarter, industry earnings took off. The survey of 23 U.S. paper companies showed profits up 41% compared with 1982, while forest products firms enjoyed a 90% increase.

Profits continued to improve dramatically as the economy boomed in early 1984, and several companies set new records for sales and earnings. Paper companies posted a 59% increase in first-quarter net income, and second-quarter figures were even more spectacular, with a *Pulp & Paper* survey of 27 paper companies showing profits jumping 88% over the previous year on sales that were up 32%. However, signs of an economic slowdown began to appear in third-quarter 1984. Paper industry production started to weaken in the fourth quarter, and price discounting began to occur in uncoated free-sheet and market pulp, reflecting excess capacity and the strong dollar. Even so, for all of 1984, year-to-year industry performance was still very favorable, with earnings jumping 45% on sales that were 15% higher than in 1983.

Overcapacity in some segments and the strong dollar plagued the industry in 1985, causing another downturn in sales and earnings. Ending a year of tough competition and difficult markets, 30 top companies reported earnings down 15% compared with 1984 and sales up a minimal 2%.

Sales and earnings bounced back in 1986, thanks in part to the steady weakening of the dollar, which began to drop in fall 1985. The cheaper dollar helped firm up export shipments and pricing, which, in turn, helped the domestic supply/demand balance for many commodity grades and allowed producers to push through some price increases. Cost controls in force at many mills also contributed to improved performance. The first quarter marked the trough of the earnings cycle, as profits of 32 top companies dropped 23% due to continued price weakness in several grade segments. Second-quarter income rose 13%, the first increase since the fourth quarter of 1983, and third-quarter profits soared 30% above the previous year on a sales increase of 5%. For the entire year, earnings climbed a solid 34% over 1985 on sales that improved by 4%. Producers of market pulp, linerboard, and uncoated free-sheet showed the biggest gains.

The upturn continued through 1987, bolstered by favorable economic and market conditions and price increases in most grade segments. A major factor was the continuing decline of the dollar, compared with other currencies, as the domestic industry enjoyed full capacity operation. Profits surged ahead in each of the quarters, ending the year with earnings 45.8% ahead of 1986 on an increase in sales of 19.7%. At the top of the heap was Georgia-Pacific, with sales of $8.6 billion.

In 1988, weakness began to creep into sectors such as newsprint and wood products but was more than offset by strong pulp and paperboard markets. For the full year, a *Pulp & Paper* survey of 27 top companies showed profits soaring 52% on a 15% increase in sales. By second-quarter 1989, however, the change in the cycle was becoming increasingly apparent as price weakness began to spread into other grades, and by the fourth quarter, earnings momentum had turned negative. For full-year 1989, profits, excluding significant nonrecurring items, were flat at $7 billion, although sales rose 11.3% to $98 billion, according to a *Pulp & Paper* survey of 32 companies. FTC data, which does not take out nonrecurring items, showed the paper industry's earnings in an even less favorable light, down 13.4% from 1989.

FINANCIAL RATIOS

After lagging the average for all manufacturing for two decades, paper industry return on net worth exceeded the average of the 1974-75 tight-market period. Return on net worth reached a peak of 16.8% in 1974, hovered in the 12% to 13% range from 1975 to 1978, and then hit 16.0% in 1979, according to FTC data. Return on net worth then slipped to the 11% to 12% range in 1980 and 1981 before plummeting to 5.5% in 1982. Subsequently, industry return on net worth began trending higher on the strength of improving profit margins. According to FTC data, the ratio topped 10% in 1984 and 1986, reached 14.1% in 1987, and set a new record in 1988 at 18.8% before sliding back to 15.4% in 1989 and to 10.6% in 1990.

Return on total capital (net worth plus long-term debt) has not kept up with return on net worth, reflecting the heavy debt loads built up by the industry. Long-term debt as a percentage of net worth rose from the low-20% range in the first half of the 1960s to an average of 47% in the 1970s. Then, in 1982, debt to net worth rose to 49% as crumbling profits undercut company balance sheets. Deterioration in this and other financial ratios caused downgrading of credit ratings for several major producers. Some companies moved to improve their liquidity in the subsequent upswing, but many major producers remain highly leveraged, with some taking on even more debt to finance large acquisitions. Indeed, debt to net worth has trended rapidly higher during the past decade. In 1980, debt to net worth was a moderate 43%; it topped 51% in 1985 and then soared to 61% in 1986. It eased slightly to 57% in 1987 but has since jumped to consecutive new highs in each of the last three years: 63% in 1988, 76% in 1989, and 86% in 1990.

United States:

CAPITAL SPENDING

After eight years of increases, U.S. pulp and paper companies trimmed their capital spending plans in 1991 in the face of deteriorating profits and sluggish growth. Companies invested heavily during the late 1980s to expand capacity, cut costs, improve product quality, and meet environmental standards, but the spending boom peaked in 1990 as the economy slid into recession.

The recession continued to take its toll on capital spending plans through mid-1991, despite signs that the economy may already have started to rebound. Earnings and capacity utilization remained down in the paper industry, forcing the decline in capital spending.

In June 1991, the Census Bureau found that the U.S. paper industry planned to cut back new plant and equipment spending to $12.6 billion in 1991, down 24.6% from 1990 outlays of $16.72 billion. The June estimate represents a further 3.8% decline in spending plans from the Census Bureau's previous survey in April. First-quarter spending was at an annual rate 2.8% lower than expected, while second-quarter outlays were off by 5.0%.

HISTORICAL TRENDS

U.S. pulp and paper companies devoted an increasing portion of their funds to capital improvements during the 1980s, both to increase capacity and to reduce costs and improve their products in order to remain competitive. In absolute terms, spending climbed from $5.24 billion in 1979 to $15.69 billion in 1989, an increase of 200%. Capital spending rose from 86% of cash flow in 1978 and 93% in 1979 to well above 100% of cash flow throughout most of the 1980s. To help pay for this increase, companies boosted their long-term debt significantly—from $10.08 billion in 1978 to $33.19 billion in 1989.

U.S. paper industry capital spending dropped 26% in the 1971 recession but rose in each of the following ten years, even through the severe 1974-75 economic downturn. During this period, environmental compliance was the major engine driving capital outlays. During the 1972-75 period, between 30% and 38% of total primary industry capital spending went for air, water, and solid waste control, according to the National Council of the Paper Industry for Air & Stream Improvement.

Following the oil-price shocks of the 1970s, a substantial percentage of industry capital was claimed by energy programs to reduce dependence on fossil fuels and to improve efficiency. That trend held steady through 1982 before dropping the following year because of the recession. Since then, cogeneration plants have become a major focus of energy spending. In many cases, these plants are being built, owned, and operated by outside contractors; the mill simply supplies fuel for the plant and takes the power generated. Because of such arrangements, interest in this type of project remained strong despite lower energy prices in the 1980s.

Skyrocketing costs. Rapid inflation in construction and capital goods costs was another major factor in the 14%/year rise in industry capital spending during the 1970s. The following comparisons, though inexact, show how the costs of building new greenfield mills in several key grades have escalated. In 1971, Weyerhaeuser Co. built a 1,600-tpd containerboard mill at Valliant, Okla., for about $100 million, or about $62,500/daily ton. Ten years later, International Paper Co.'s 2,070-tpd Mansfield, La., mill was completed for about $600 million, or about $290,000/daily ton. Mead Corp. completed work in 1990 on a 1,000-tpd unbleached kraft boxboard and linerboard mill at Mahrt, Ala. The new facility cost $556 million, or about $556,000/daily ton.

Weyerhaeuser completed a 600-tpd kraft market pulp mill at New Bern, N.C., in 1970 for $50 million, or $83,000/daily ton. Great Northern Nekoosa Corp.'s 1,030-tpd greenfield Leaf River market pulp mill, started up in 1984, cost $560 million, or roughly $544,000/daily ton. Parsons & Whittemore Inc. is building a new 1,400-tpd bleached softwood kraft market pulp plant at its existing mill complex at Claiborne, Ala. On track for startup in late

1991, the $700-million facility will cost about $508,000/daily ton.

Started up in 1984, Union Camp Corp.'s integrated 600-tpd uncoated free-sheet mill at Eastover, S.C., cost $485 million, or $808,000/daily ton. In contrast, Champion International Corp. built a $100-million, 500-tpd bleached kraft pulp and paper mill at Courtland, Ala., in 1971 for $200,000/daily ton. Union Camp expanded the Eastover mill in 1991 in a $700-million program (about $631,000/daily ton) to add 290,000 tpy of uncoated free-sheet and 105,000 tpy of bleached kraft market pulp. Willamette Industries Inc. completed construction of a new 200,000-tpy uncoated free-sheet mill at Bennettsville, S.C., in 1990 for an estimated cost of $325 million, or $578,000/daily ton.

Solid evidence for the current slowdown began to appear early in 1990 as companies lowered their capital plans. In late 1989, the industry reported plans to spend $17.92 billion on capital projects in 1990, according to the Bureau of Census. In April 1990, however, that figure had fallen by about $200 million, or 1.1%, from the earlier forecast. A downward revision of 5.1% in planned outlays for the second quarter was responsible for the decline. Further downward revisions followed as the industry responded to slower growth in demand, excess capacity in some grade segments, and reduced profitability.

Despite the slowdown, capital spending still managed to set a new record in 1990 of $16.72 billion, and paper producers were responsible for the largest percentage increase in capital spending among major U.S. manufacturing industries. In percentage terms, however, the 7.3% increase for paper industry spending in 1990 was down sharply from the 42.7% increase seen in 1989.

SPENDING PLANS: 1991 AND BEYOND

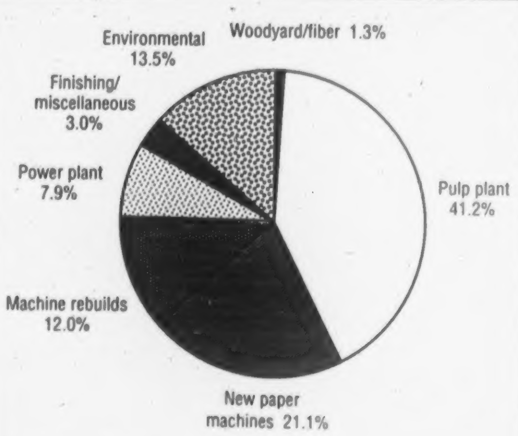
Pulp & Paper Project Report's mid-year 1991 survey of spending plans for the 1991-93 period confirmed the slowdown in spending that began in 1990. U.S. companies reported plans to spend $13.3 billion on projects for completion during the 1991-93+ period, down 13.3% from plans reported a year earlier for the 1990-92+ period.

The capacity expansion boom that drove spending plans to record levels in the late 1980s played itself out in 1991, leaving environmental improvements as the main engine of capital spending. At existing mills, environmental projects account for 13.5% of total spending plans, up from 7.9% in 1990 and 3.8% in 1989. Mills will be scrambling to comply with stricter regulations covering dioxin formation, odor control, and recycled fiber content.

Virtually all of the major capacity additions in newsprint and uncoated free-sheet have been completed, and capacity growth will be strongest for the next couple of years in the recycled grades, including tissue, newsprint, and containerboard. Deinked pulp installations are booming thanks to legislated demand for recycled-content papers, and the major tissue producers are gearing up for a period of above-average capacity expansion.

One effect of the recession has been to push spending into future years. While only a few major projects have been canceled outright, over 20 have been postponed, including new paper machine installations planned by Boise Cascade Corp., Champion International, Federal Paper Board Co. Inc., Westvaco Corp., and Weyerhaeuser. Spending plans for 1991 were largely locked in since most projects were either completed in the first half or under way

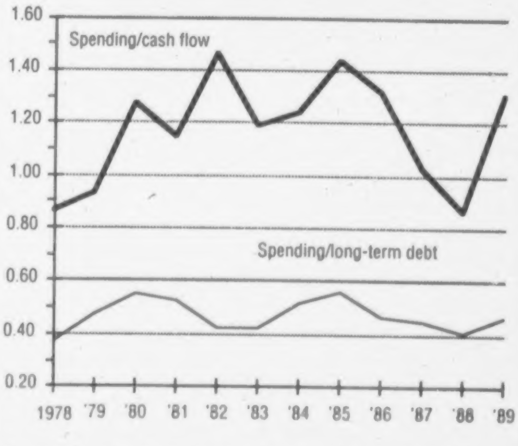
ESTIMATED CAPITAL SPENDING AT EXISTING MILL SITES, BY PROCESS AREA



Total: $10,345,959

Source: *Pulp & Paper Project Report.*

RATIO OF CAPITAL SPENDING vs CASH FLOW AND LONG-TERM DEBT



Sources: American Paper Institute, Federal Trade Commission, Bureau of the Census for completion in the second half, but projects planned for the future have been pushed back from 1992 into 1993 and beyond. Projects slated for startup in 1991 account for $6.5 billion of U.S. spending plans. Announcements through mid-1991 totaled $2.0 billion for 1992, $3.7 billion for 1993, and just over $1.0 billion for 1994-95.

Projects announced for startup in 1993 comprise an unusually high 28% of overall planned spending. Since spending for projects targeted for startup in 1993 will start in 1992, the numbers suggest a pickup in spending during 1992 after the 1991 downturn, barring further deferrals.

The backlog of proposed projects has also grown dramatically. These projects, which are under consideration but have not been scheduled, now amount to $8.0 billion, up over 150% from 1990. This total includes several speculative projects that are seeking financing, however, and it is doubtful that many of them will be approved during the current slump.

Among U.S. companies with the largest capital programs are International Paper, Champion International, and Weyerhaeuser Paper Co. Scott Paper Co. planned to spend about $1.4 billion over the 1990-91 period, and although specific spending amounts are not available, Procter & Gamble Co. has announced plans for a major expansion of its toilet tissue and paper towel business. Temple-Inland Inc. is another company that is gearing up for a major round of mill improvements, focusing on recycled containerboard grades.

CAPITAL SPENDING PLANS OF MAJOR U.S. PAPER COMPANIES

(million $)

	1991e	1990	Change (%)
Bowater	$200	$214	-6.5%
Champion International	600-700	1,047	-37.9
Chesapeake	105	125	-16.0
Consolidated Papers	335	305	9.8
Federal Paper Board	260	509	-48.9
Georgia-Pacific	600-650	866	-27.8
P.H. Glatfelter	100	40	150.0
ITT Rayonier	94	38	147.4
International Paper	1,100	1,267	-13.2
Longview Fibre	60+	133	-54.9
Louisiana-Pacific	125-150	375	-63.2
Manville	170	234	-27.4
Mead	350	455	-23.1
Mosinee	100	25	300.0
Pentair	23	23	—
Potlatch	346	265	30.6
St. Joe Paper	0	104	-100.0
Scott Paper	350-400	815	-54.0
Smurfit	125-150	192	-28.1
Sonoco Products	100-110	118	-11.0
Stone Container	325	552	-41.1
Union Camp	500	935	-46.5
Westvaco	360	487	-26.1
Weyerhaeuser Paper	55	550	-90.0
Total	**6,514**	**9,674**	**-32.7**

Source: *1991 Pulp & Paper Company Profiles; Pulp & Paper Project Report.*

Georgia-Pacific Corp. plans to reduce debt it incurred in the acquisition of Great Northern Nekoosa in 1990 as rapidly as possible. Analysts report that G-P management is determined to keep capital spending as low as possible during this period, somewhere in the $400- to $500-million range required to cover annual maintenance costs.

James River Corp. announced a major reorganization in August 1990 that will lead to sweeping changes in the company's structure. One consequence of the restructuring will be an increase in capital spending to expand the company's core businesses.

Overall spending plans totaled $13.3 billion in the mid-1991 *Project Report* review, down 13.3% from a year earlier. Spending for environmental improvements jumped to $1.9 billion, as four years of increases pushed environmental spending to its highest level since the 1970s. Higher spending for environmental programs will be necessary over the next several years to comply with more stringent regulation of both water and air pollution.

Projects to combat water pollution remain the industry's highest environmental priority, particularly to limit dioxin formation at bleached kraft pulp mills. Spending plans for water quality improvements total $1.3 billion for the 1991-93 period, $495 million for air quality improvements, and $71 million for solid waste management. These figures are quite conservative since a significant portion of pulp mill spending is in fact driven by environmental considerations.

Pulp mill expansion and modernization projects captured the largest share of spending in this year's survey.

U.S. PAPER INDUSTRY CAPITAL SPENDING FORECAST FOR 1991

(billion $)

	1991e	1990	% change
Annual spending			
Paper	$12.60	$16.72	-24.6%
All manufacturing	190.17	192.78	-1.4
Quarterly spending (seasonally adjusted annual rate)			
Paper			
1Q	13.07	17.56	-25.6
2Q	12.63	18.59	-32.1
3Q	12.10	16.74	-27.7
4Q	12.58	14.02	-10.3
All manufacturing			
1Q	190.11	191.36	-0.7
2Q	191.11	195.16	-2.1
3Q	191.45	194.48	-1.6
4Q	188.00	190.14	-1.1

e = Estimate.
Source: Bureau of the Census.

Mills reported plans to spend $5.7 billion on pulping projects during the 1991-93 period, or 50% of overall spending. Pulp mill spending accounted for 41% of total outlays in the 1990 survey and 38% the year before.

Capacity expansion, environmental upgrading, and cost reduction are the three most important factors in current pulp mill spending plans. Mills are expanding both market pulp capacity and captive pulp capacity to support more paper and paperboard production. Environmental improvements center on odor control and on reducing chlorine use to limit dioxin formation.

High prices and tight markets made market pulp capacity expansion the driving force behind pulp mill spending in the late 1980s, leading to a number of expansion projects scheduled to come online in the 1990-92 period. Several of these projects are at mills that did not previously produce market pulp.

Four major projects completed in 1990 will add almost 500,000 tpy of bleached kraft market pulp capacity at a cost of over $800 million. In the largest, Weyerhaeuser started up a new 358,000-tpy mill at its Columbus, Miss., facility at a cost of $500 million. Bowater Inc. built a complete new bleached kraft pulp mill at Calhoun, Tenn., at a cost of $205 million. The other two projects improve existing facilities at James River, Camas, Wash., and Louisiana-Pacific Corp., Samoa, Calif.

In late 1991, Parsons & Whittemore will complete construction of a new $700-million bleached softwood kraft market pulp mill at Claiborne, Ala. The Alabama Pine Co. mill will have capacity for 1,250 metric tpd. Stone Container Corp.'s Port Wentworth, Ga., mill started up a new 740-tpd bleached hardwood kraft market pulp mill as part of a $335-million modernization, and Union Camp completed a 105,000-tpy market pulp facility in its $675-million expansion program at Eastover. Potlatch Corp. plans a new oxygen delignification system and single pulp line to add 45,000 tpy to bleached kraft pulp capacity at Lewiston, Idaho, at a cost of $105 million. A four-year, $408-million modernization at Champion International's Courtland, Ala., mill for completion in 1993 includes 250,000 tpy of new bleached kraft pulp capacity.

Faced with a solid waste problem that threatens to grow to crisis proportions, more than a dozen states are considering or have already passed laws mandating increased use of recycled fiber in newsprint and other paper grades. This situation has led to a boom in secondary fiber expansion projects and proposals, as papermakers scramble to position themselves for what promises to be a very different market. At least 14 newsprint producers in the U.S. are planning to add deinking facilities over the next three years.

While virgin newsprint is suffering the effects of overcapacity, there could be a shortage of recycled newsprint over the next few years. Virtually all North American newsprint producers that are not using any secondary fiber currently are seriously considering some type of expansion into recycled newsprint—including those that are far away from wastepaper sources, such as Georgia-Pacific's East Millinocket, Maine, mill. Southeast Paper Manufacturing Co.'s new 210,000-tpy recycled newsprint machine, started up in 1989, is the sole new newsprint machine among the current crop of expansions to produce recycled grades. Alabama River Newsprint Co., which just came online in summer 1990, has announced a plan to install a 360-metric-tpd deinking plant at a cost of $55.6 million to allow production of 40% recycled-content newsprint. Smurfit Newsprint Corp. has approved plans to build a new 255,000-metric-tpy recycled newsprint mill in New York, but the company has not yet announced the location. New recycled paperboard mills have been proposed for the

U.S. PAPER AND ALLIED PRODUCTS COMPANIES' CAPITAL SPENDING RELATED TO PROFITABILITY AND CAPACITY UTILIZATION

Year	Capital spending[1] (million $)	Change (%)	Net profit after taxes[2] (million $)	Change (%)	Operating rate[3]
1990	$16,720	7.3%	$4,882	-30.7%	93.7%
1989	15,580	42.7	7,047	-12.8	93.0
1988*	10,920	21.2	8,081	46.4	95.3
1987*	9,010	2.7	5,520	52.1	95.2
1986	8,770	2.1	3,280	13.9	93.7
1985*	8,590	19.1	2,880	-4.1	90.3
1984	7,210	21.8	3,015	29.0	93.6
1983*	5,920	5.7	2,327	60.1	91.4
1982	5,600	-8.3	1,460	-53.0	84.6
1981*	6,110	-6.3	3,110	53.0	91.1
1980*	6,520	24.4	2,800	-45.4	91.9
1979	5,240	37.9	3,723	40.6	94.5
1978*	3,800	9.2	2,598	18.5	92.8
1977*	3,480	16.4	2,367	-1.6	91.4
1976	2,990	2.0	2,270	26.0	89.7
1975	2,930	1.7	1,801	-17.5	79.8
1974*	2,880	44.7	2,287	51.5	93.7
1973*	1,990	36.3	1,441	53.1	96.9
1972	1,460	13.2	941	83.8	96.4
1971*	1,290	-25.9	512	-28.8	91.9

*Revised for change in corporate structure of the industry. Percent changes for sales and profits are computed from data (not shown) consistent with previous year.

Sources: 1. Bureau of the Census. 2. Federal Trade Commission. 3. American Paper Institute (Paper and Paperboard only).

Northeast by Dunkirk Containerboard in New York and Northampton Paperboard in Pennsylvania. On the West Coast, North Pacific Paper Corp. has approved a plan to install a new newsprint machine at Longview, Wash., that includes a deinking facility capable of supplying 25% of overall mill needs.

Spending for paper machine modifications and improvements is down 42% from last year's survey. Announced spending plans for scheduled rebuild projects total $1.2 billion for the 1991-93 period. U.S. mills report plans to spend $1.1 billion on power plant improvements during the 1991-93 period, about 10% of total expenditures.

New paper machines account for 23% of announced spending plans for the 1991-93 period. New paper machine announcements climbed dramatically in the late 1980s, and now 12 new machines at existing mills and another nine machines at new mills are scheduled for startup during the 1991-94 period. The most active grades for new machines are tissue, coated and uncoated free-sheet papers, newsprint, kraft paperboard, and recycled paperboard.

Eleven new paper machines came online in 1990, seven at existing mills and four at greenfield facilities. Mead completed a new $556-million coated natural kraft paperboard mill at Phenix City, Ala. Gaylord Container Corp. started up a new 1,000-tpd linerboard machine at Bogalusa, La., the first new linerboard unit to be built since 1985. Union Camp's $375-million modernization and expansion at Savannah, Ga., will replace two older units with a new kraft linerboard machine in 1991, and Jefferson Smurfit Corp. plans a new linerboard machine for its Fernandina Beach, Fla., mill.

In uncoated free-sheet, Willamette Industries started up a greenfield mill at Bennettsville in 1990, and Boise Cascade completed an extensive $525-million modernization and expansion program at International Falls, Minn. Union Camp completed a $700-million expansion in 1991 that includes a new paper machine at its Eastover mill. Also in 1991, Georgia-Pacific completed a $500-million expansion at Ashdown, Ark., adding 325,000 tpy.

Champion International installed a new coated free-sheet unit at its Quinnesec, Mich., market pulp mill in 1990, and Scott Paper's S.D. Warren Div. built another lightweight coated free-sheet unit at Skowhegan, Maine. In 1991, Consolidated Papers Inc. will complete installation of a new $400-million coated free-sheet machine at the Wisconsin Rapids Div. Boise Cascade announced plans for a $450-million coated groundwood expansion at Rumford, Maine, targeted for completion in late 1993, but the project has been deferred due to poor market conditions.

Chesapeake Corp.'s Wisconsin Tissue Mills facility in Menasha, Wis., started up a new recycled tissue mill in 1990, and Kimberly-Clark Corp. brought online a new tissue mill at Jenks, Okla. Kimberly-Clark will start up a second new mill in 1991 at Loudon, Tenn. Fort Howard Corp. is installing a fourth recycled tissue machine in 1991 at Rincon, Ga., and has announced plans for new capacity at Muskogee, Okla., and Green Bay, Wis., as well as a fifth machine for Rincon in the mid-1990s. Procter & Gamble plans to install two new tissue machines at mills east of the Rockies by 1993. The company is also studying expansion opportunities on the West Coast that could include another machine or even a new mill.

CAPITAL SPENDING BY U.S. PAPER AND ALLIED PRODUCTS ESTABLISHMENTS

(million $)

Year	Total (SIC 26)	Pulp mills	Paper mills	Paperboard mills	Converting plants		Building paper/board mills
					Paper	Containers and boxes	
1987	$5,905	$359	$2,763	$795	$1,163	$826	n.a.
1986	6,084	875	2,153	1,000	1,247	799	$10
1985	6,273	745	2,484	1,043	1,218	764	18
1984	5,302	600	2,412	680	906	681	21
1983	4,987	916	2,239	527	820	470	15
1982	5,098	659	1,856	1,287	786	496	15
1981	5,202	522	2,435	974	746	499	27
1980	5,128	250	1,897	1,539	775	628	40
1979	4,447	240	1,714	1,229	725	491	48
1978	3,736	195	1,424	1,000	604	496	19
1977	3,295	301	1,115	934	507	421	17
1976	3,010	375	1,044	844	394	335	12
1975	2,718	294	832	807	412	347	26
1974	2,214	136	723	637	315	342	63
1973	1,530	119	508	344	304	227	26
1972	1,335	136	372	314	289	206	19
1971	1,197	135	374	228	262	180	18
1970	1,397	122	503	239	289	227	18

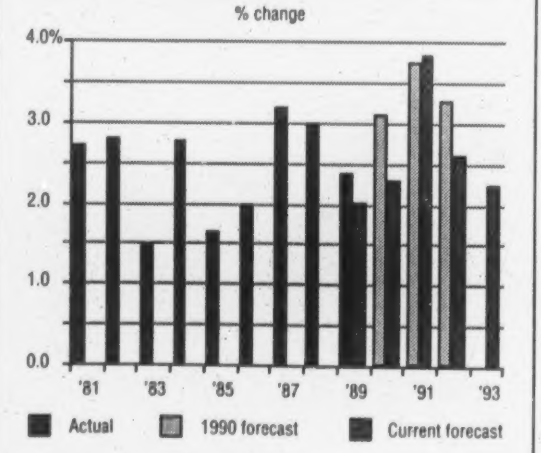
Source: Bureau of the Census.

United States:

CAPACITY EXPANSION

Capacity expansion in the paper industry behaves in a classically cyclical fashion, with each grade responding to changes in its own supply/demand equation. During periods of strong demand, production begins to put a strain on supply and prices rise, providing companies with the profits necessary to add capacity. Complicating the picture are the huge amounts of capital and the long lead times required to bring new tonnage online—two or three years and from $300 million on up for a new mill, for example.

ANNUAL GROWTH RATE OF PULP AND PAPER CAPACITY



Ten-year annual average for 1981-90: 2.4%
Average for three-year survey period, 1991-93: 2.9%

Source: American Paper Institute

Even more volatile cycles occurred during the 1970s and 1980s because of exchange-rate fluctuations, which can completely turn around a country's competitive position. With such forces at work, it is not surprising that expansion cycles often get out of hand, especially in commodity grades, such as newsprint, market pulp, and linerboard, which are affected by capacity changes and trade conditions around the world.

Although the 3.8% rate of growth expected for 1991, according to the American Paper Institute's annual capacity survey, is the highest one-year rate of growth since 1973, a 2.9% average annual growth rate is expected for 1991-93, considerably lower than the 3.4% annual growth rate reported by producers last year. But the average annual growth rate of 2.9% for the next three years is about 21% higher than the ten-year average of 2.4% annually for 1981-90. The 1992 capacity level is now expected to be 1.7% below the 1992 level reported in last year's survey. Expansion plans are running well below last year's estimates for 1992 due to cutbacks in the printing and writing grades and a new emphasis on recycled grades.

The grade showing the highest rate of growth in the past year is recycled paperboard, particularly linerboard. Newsprint also shows a strong rate of growth this year, while printing and writing grades have been revised slightly downward for the second time. Other grades showing a high rate of growth in percentage terms are tissue, at a rate slightly higher than the ten-year average in 1980-90, solid bleached paperboard, and recycled paperboard, particularly recycled containerboard. Woodpulp will show a marked decrease in the period 1991-93 from 1980-90, although market woodpulp will be well above the ten-year period in the next three years.

Paper and paperboard capacity totaled 82.1 million tons in 1989, about 0.2% more than preliminary figures indicated last year. Capacity in 1990 totaled 84 million tons, up 1.9% from 1989. Over the 1991-93 period, producers plan to add another 7.5 million tons to capacity, a three-year increase of 8.7%. That translates into an average annual growth rate of 2.9%, which is about 0.5% lower than the annual average over the past ten years. The strongest growth will come in 1991, when mills plan to add 3.2 million tons for a one-year gain of 3.8%.

Thirteen new paper and paperboard machines were brought online in 1990, and at least 18 additional machines are scheduled to come onstream by 1993. New paper and paperboard machine installations in existing mills comprise the largest single component of growth in the API survey, representing 4.1 million tons, or 54.9% of all new capacity. New machine installations in greenfield mills represent 130,000 tons, or 1.7% of the total. Machine rebuilds and other miscellaneous improvements will account for the remaining 3.2 million tons, which comprise 43.4% of the net capacity gain. The projected growth in paper and paperboard capacity will raise the U.S. industry's potential annual production to 91.5 million tons in 1993.

Consumption of woodpulp, wastepaper, and other fibrous materials as furnish for papermaking will increase at a 3.5% annual rate over the next three years, reaching 92.6 million tons by 1993. Woodpulp will continue to be the industry's primary fiber source, but wastepaper use is projected to grow at more than twice the rate of virgin fiber use, reaching 29.3% of all fiber consumed at domestic mills by 1993. This exceeds the level projected by producers in last year's survey. Higher levels of wastepaper consumption will be aided by the introduction of major recycling projects throughout the U.S.

A total of 3.6 million annual tons of chemical pulps will be added in the period 1991-93, which accounts for almost all of the capacity expansion for woodpulp in the period. About 87%, or 3.1 million tons, will be in the bleached grades, which are used in printing and writing papers and food packaging. The remaining 13% will be in unbleached grades used to make containerboard and other packaging grades. Capacities for dissolving and special alpha pulps will remain unchanged, and no growth in capacity is planned for sulfite or semichemical pulps.

Mechanical pulp grades have grown at a faster rate than chemical grades of woodpulp in recent years due to the successful introduction of thermomechanical pulp (TMP) and chemi-thermomechanical pulp. However, capacity expansion plans in groundwood pulps and TMP are being scaled back due to increased use of deinked wastepaper in the fiber mix at newsprint and groundwood printing paper mills. Mechanical pulp capacity for 1991-93 will grow only 0.3%, or 62,000 tons, annually. Facilities totaling almost 600,000 annual tons of mechanical pulp will be shut down in the period 1991-93, mostly to accommodate the increased consumption of old newspapers (ONP) and magazines. Last year's API survey forecast 437,000 tons more mechanical pulp capacity in 1992 than did this year's survey.

Market pulp capacity expansion will significantly increase in the next three years, even though growth in total woodpulp capacity has slowed, spurred by worldwide demand and high prices for bleached pulp. Market pulp capacity will increase at a 5.2% annual rate, growing from 7.4 million tons in 1990 to 8.6 million tons in 1993. Expansion plans continue to grow, raising the three-year growth outlook from 4.5% a year in last year's API survey. The ten-year growth rate for market pulp has averaged 3.7% a year.

Consumption of wastepaper in the manufacture of paper and paperboard will grow from an estimated 22 million tons in 1990 to about 27 million tons by 1993. The growth rate for wastepaper consumption will average 7.2% annually over the next three years—more than twice as fast as all other fiber sources, up from an average annual growth rate of 5.9% projected last year for the period 1989-92. The percentage of wastepaper used by the industry will increase from 26.3% of fiber supply in 1990 to 29.3% in 1993. In early 1990, the industry announced a national goal of 40% paper recovery for recycling by the end of 1995—a 50% in-

GROWTH TRENDS IN U.S. PAPER AND PAPERBOARD CAPACITY[1]

(000 short tons)

Year	Total paper and board	Change (%)	Total paper	Change (%)	Total paperboard	Change (%)
1993e	91,527	2.2%	45,923	1.7%	45,604	2.7%
1992e	89,519	2.6	45,135	2.7	44,384	2.5
1991e	87,260	3.8	43,969	4.2	43,292	3.5
3-year change and average annual rate	7,487	2.9	3,711	2.8	3,776	2.9
1990e	84,040	2.3	42,212	2.5	41,828	2.0
1989	82,158	2.0	41,165	2.4	40,993	1.7
1988	80,533	3.0	40,211	2.9	40,322	3.1
1987	78,186	3.2	39,080	2.8	39,106	3.6
1986	75,777	2.0	38,014	1.2	37,763	2.8
1985	74,301	1.6	37,581	1.3	36,720	2.0
1984	73,098	2.8	37,106	4.0	35,992	1.5
1983	71,126	1.5	35,675	2.9	35,451	0.1
1982	70,086	2.8	34,665	2.8	35,421	2.8
1981	68,172	2.7	33,706	3.2	34,466	2.2
1980	66,368	2.7	32,659	4.7	33,709	0.8
10-year change and average annual rate	17,670	2.4	9,552	2.6	8,118	2.2

e = Estimate.

[1] Excludes construction paper and board.

Source: American Paper Institute.

GROWTH TRENDS IN U.S. PAPERBOARD GRADES CAPACITY[1]

(000 short tons)

Year	Unbleached kraft	Change (%)	Solid bleached	Change (%)	Semi-chemical	Change (%)	Recycled	Change (%)
1993e	22,829	0.2%	5,289	4.6%	6,072	1.5%	11,415	8.1%
1992e	22,785	2.7	5,056	4.4	5,982	2.9	10,560	1.0
1991e	22,180	3.9	4,843	4.8	5,812	0.6	10,455	4.3
3-year change and average annual rate	1,491	2.3	670	4.6	226	1.3	1,389	4.4
1990e	21,338	2.2	4,619	-2.1	5,845	1.1	10,026	4.3
1989	20,878	3.0	4,716	-0.4	5,781	0.1	9,617	0.9
1988	20,269	4.4	4,733	0.0	5,788	1.9	9,532	2.9
1987	19,421	4.3	4,735	3.5	5,682	2.2	9,267	2.9
1986	18,622	2.6	4,576	4.7	5,557	2.7	9,008	2.4
1985	18,144	1.7	4,370	4.4	5,411	3.0	8,795	0.8
1984	17,834	1.8	4,185	1.4	5,252	2.6	8,722	-2.7
1983	17,511	.6	4,129	0.1	5,119	-1.7	8,962	3.1
1982	17,402	4.0	4,123	-0.4	5,207	4.4	8,690	1.1
1981	16,738	4.8	4,141	-0.9	4,988	0.8	8,599	-0.2
1980	15,967	2.7	4,180	-2.1	4,946	1.7	8,617	-1.6
10-year change and average annual rate	5,371	2.9	439	1.0	899	1.7	1,409	1.5

e = Estimate.

1. Excludes construction board.

Source: American Paper Institute.

GROWTH TRENDS IN U.S. PAPER GRADES CAPACITY[1]

(000 short tons)

Year	Newsprint	Change (%)	Printing/ writing	Change (%)	Packaging and converting	Change (%)	Tissue	Change (%)
1993e	7,430	1.3%	26,488	2.2%	5,655	0.1%	6,349	1.8%
1992e	7,335	2.6	25,918	3.3	5,647	0.6	6,235	2.0
1991e	7,151	4.7	25,089	4.8	5,615	2.7	6,113	2.3
Three-year change and average annual rate	602	2.9	2,456	3.4	189	1.1	373	2.0
1990e	6,828	8.4	23,942	1.3	5,466	0.6	5,976	3.1
1989	6,296	3.0	23,637	2.6	5,435	0.6	5,798	2.3
1988	6,115	1.8	23,027	4.3	5,402	-1.6	5,667	2.9
1987	6,006	3.5	22,077	5.2	5,492	-4.6	5,505	0.6
1986	5,804	.3	20,980	2.5	5,758	-3.8	5,472	2.4
1985	5,788	-1.1	20,463	2.9	5,985	-1.7	5,345	1.3
1984	5,851	1.3	19,890	6.7	6,088	0.2	5,276	1.7
1983	5,774	2.1	18,633	4.6	6,078	0.0	5,190	1.3
1982	5,654	3.6	17,809	2.9	6,076	2.8	5,125	1.8
1981	5,457	12.8	17,302	3.0	5,913	-2.6	5,035	1.6
1980	4,836	15.2	16,798	4.6	6,072	.3	4,954	1.7
Ten-year change and average annual rate	1,992	2.6	7,144	3.6	-606	-1.0	1,022	1.9

e = Estimate.

1. Excludes construction paper.

Source: American Paper Institute.

crease over the 1988 level. Primary and secondary woodpulp sources will drop from 73.6% of fiber supply in 1990 to 70.7% in 1993.

Most states have implemented laws urging manufacturers to use more recycled fiber. This situation has led to a boom in secondary fiber expansion projects and proposals as papermakers scramble to position themselves to comply with the new recycling mandate. Most wastepaper has traditionally been consumed at paperboard mills, but expansions in recycled tissue and newsprint have accelerated. At least 16 deinking projects will start up in 1991 at new or existing mills. Most deinking projects this year continue to be in newsprint or market deinked pulp mills that sell to newsprint manufacturers, but projects for other grades also are increasing.

Newsprint capacity will increase from 6.8 million tons in 1990 to 7.4 million tons in 1993, a 2.9% average annual growth rate from 1991-93. This growth is preceded by an 8.4% increase in 1990, as new production from four new paper machines that started up in the 1989-90 period enters the market. This one-year increase exceeds all gains in newsprint capacity over the previous six years and will raise capacity by 532,000 tons in 1990. Productivity gains from these machines, together with the added capacity from Weyerhaeuser Co.'s new machine scheduled to start up in 1991, will add an additional 603,000 tons by 1993.

In addition to these capacity expansions, at least 14 U.S. newsprint producers are also planning to install deinking fa-

GROWTH TRENDS IN U.S. WOODPULP CAPACITY[1]

(000 short tons)

Year	Total pulp	Change (%)	Market pulp	Change (%)
1993e	69,193	0.1%	10,643	0.3%
1992e	69,113	2.5	10,606	8.4
1991e	67,440	3.0	9,786	4.1
Three-year change and average annual rate	3,689	1.8	1,243	4.2
1990e	65,504	1.9	9,400	3.9
1989	64,289	2.1	9,047	1.6
1988	62,950	2.9	8,908	4.7
1987	61,172	2.4	8,505	5.8
1986	59,750	1.9	8,039	.6
1985	58,641	1.6	7,989	6.1
1984	57,742	2.8	7,530	1.6
1983	56,143	0.0	7,414	4.7
1982	56,125	2.2	7,079	1.5
1981	54,891	3.1	6,972	2.5
1980	53,215	3.1	6,801	7.4
Ten-year change and average annual rate	12,289	2.1	2,599	3.3

e = Estimate.

[1] Excludes pulp for construction paper and board.

Source: American Paper Institute.

GROWTH TRENDS IN U.S. PULP GRADES CAPACITY[1]

(000 short tons)

	Dissolving and special alpha	Change (%)	Sulfite	Change (%)	Sulfate, soda, and screenings	Change (%)	Semi-chemical	Change (%)	Mechanical	Change (%)
1993e	1,527	0.0%	1,638	-2.8%	54,391	0.4%	4,706	-0.1%	6,931	-0.8%
1992e	1,527	0.0	1,685	0.8	54,199	3.1	4,713	0.0	6,989	0.6
1991e	1,527	0.2	1,671	0.8	52,585	3.6	4,714	0.6	6,944	1.1
3-year change and average annual rate	3	0.1	-20	-0.4	3,626	2.3	18	0.1	62	0.3
1990e	1,524	4.0	1,658	0.9	50,765	2.0	4,688	-1.4	6,869	3.5
1989	1,465	1.0	1,644	1.0	49,790	2.3	4,753	-0.7	6,636	3.2
1988	1,450	4.4	1,627	-1.2	48,654	3.1	4,787	1.9	6,432	2.8
1987	1,389	-0.7	1,646	-3.3	47,185	2.7	4,697	1.4	6,256	3.3
1986	1,399	-3.8	1,703	-2.0	45,952	2.5	4,631	-0.4	6,058	1.6
1985	1,454	-2.2	1,738	-0.7	44,835	2.5	4,650	0.5	5,964	-2.6
1984	1,487	-2.5	1,750	-2.1	43,758	2.9	4,625	3.0	6,122	5.3
1983	1,525	-5.0	1,788	0.4	42,526	0.7	4,490	-5.2	5,814	0.6
1982	1,606	0.5	1,780	-4.0	42,225	2.1	4,734	3.0	5,780	5.2
1981	1,598	0.5	1,855	-2.8	41,346	3.3	4,597	-0.1	5,494	8.4
1980	1,590	2.5	1,909	-4.7	40,044	2.8	4,601	1.1	5,070	10.9
10-year change and average annual rate	-66	-0.4	-251	-1.4	10,721	2.4	87	0.2	1,799	3.1

e = Estimate.

[1] Excludes pulp for construction paper and board.

Source: American Paper Institute.

cilities at their existing mills. This will increase the consumption of ONP at these mills by 808,000 tons, or almost 50%, between 1990 and 1993.

Capacity for printing and writing papers is expected to increase 3.4% yearly over the next three years, slightly below the 3.6% growth rate projected in 1990. This rate follows a below-trend 1.3% capacity increase for printing and writing papers in 1990. Five new paper machines that will produce uncoated and coated free-sheet grades are scheduled to be brought online in 1991 and 1993 by Consolidated Papers Inc., Boise Cascade Corp., Georgia-Pacific Corp., Union Camp Corp., and Champion International Corp. Between 1991-93, capacity for uncoated free-sheet will climb 2.9%, or a total of 1.2 million tons. Coated free-sheet growth will average 4.% a year, raising capacity 1.1 million tons by 1993.

In contrast to the free-sheet grades, capacity gains for uncoated and coated groundwood papers will come from rebuilding or upgrading existing machines. Uncoated groundwood capacity will remain virtually unchanged, while coated groundwood capacity will increase by only 1.7% annually in the 1991-93 period. In the last two years, Blandin Paper Co., Bowater Inc., and Fraser Inc. have all canceled plans for new lightweight coated paper machines, and Boise Cascade delayed a project. Lake Superior Paper Industries Inc. and Daishowa America Co. have canceled plans for new groundwood paper machines.

Tissue producers plan to add 373,000 annual tons of new capacity in the next three years. After a 3.1% capacity increase in 1990, these additions will yield a 2% annual average rate of increase, continuing a long-term growth trend that has averaged 1.9% annually over the last ten years. Industry capacity will increase from 5.9 million tons in 1990 to 6.3 million tons in 1993. In the period 1990-93, eight new tissue machines installed by six different companies—Chesapeake Corp., Fort Howard Paper Co., Kimberly-Clark Corp., Mosinee Paper Corp., Potlatch Corp., and Procter & Gamble Co.—will supply 96% of the total increase. Four of these new machines will rely on deinked wastepaper for their fiber supply. The average new tissue machine produces about 70,000 tons annually.

REGIONAL CAPACITY DISTRIBUTION

(000 short tons)

	1993e	1989	1980	1975
Total paper/board[1]				
New England	6,614	6,209	5,536	5,106
Mid-Atlantic	5,553	5,440	5,801	5,760
East North Central	14,438	12,893	10,440	10,110
West North Central	2,456	1,835	1,290	1,193
South Atlantic	21,991	19,961	16,455	14,396
East South Central	12,806	10,992	8,152	7,380
West South Central	14,354	12,815	9,632	8,487
Mountain and Pacific	13,314	12,013	9,364	8,423
Total U.S.	91,527	82,158	66,670	60,855
Total woodpulp[1]				
New England	3,497	3,411	3,123	2,736
Mid-Atlantic	1,413	1,437	1,315	1,285
East North Central	4,036	4,040	3,188	2,906
West North Central	1,000	793	577	685
South Atlantic	21,671	20,297	16,902	15,220
East South Central	13,996	11,832	9,062	7,675
West South Central	12,500	11,765	9,821	8,971
Mountain and Pacific	11,081	10,714	9,228	8,861
Total U.S.	69,193	64,289	53,216	48,339

Regions are as follows:
New England: Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island.
Mid-Atlantic: New York, Pennsylvania, New Jersey.
East North Central: Wisconsin, Michigan, Illinois, Indiana, Ohio.
West North Central: North Dakota, South Dakota, Minnesota, Nebraska, Iowa, Kansas, Missouri.
South Atlantic: Delaware, Maryland, West Virginia, Virginia, North Carolina, South Carolina, Georgia, Florida.
East South Central: Kentucky, Tennessee, Mississippi, Alabama.
West South Central: Oklahoma, Arkansas, Texas, Louisiana.
Mountain/Pacific: Washington, Oregon, California, Nevada, Idaho, Montana, Wyoming, Utah, Arizona, New Mexico.

e = Estimate.
1. Excludes construction paper and board and pulp to produce these grades.
Source: American Paper Institute.

Although last year's survey forecast a 1.1% annual rate of growth in the kraft and specialty packaging grades, this year's API survey shows that the permanent shutdown of small, older machines in the next three years will offset capacity increases from a new machine brought online in 1990. Capacity in this area should decline slightly to an annual level of 2.7 million tons by 1993.

Producers of unbleached kraft paperboard will add 2.4 million tons of new capacity in the next three years, which represents a 2.8% annual growth rate. This rate is lower than last year's projected 3.7% annual growth rate, but it is close to the 2.9% annual growth rate for total paper and paperboard and consistent with the 2.7% historical annual rate of growth in capacity over the previous ten years. Kraft linerboard will increase at a below-average rate of 1.9% annually, reaching 20.7 million tons in 1993. Gaylord Container Corp. started up a new kraft linerboard machine in 1990, but no other new machines are scheduled to come online following Union Camp's startup of a new machine in 1991.

Recycled linerboard will grow at a high annual rate of 39% to reach 1.4 million tons in 1993, from a small base of only 458,000 tons, or 2.3% of total 1990 linerboard capacity. Recycled corrugating medium will increase at a lower 2.5% annual rate to reach 2.4 million annual tons in 1993. These recycled capacity gains will come from greenfield mills, the restart of idle machines and mills, and the installation of recycling plants at existing kraft and semichemical mills to permit greater use of wastepaper. Temple-Inland Inc. has announced plans to build a new recycled containerboard mill in the U.S., which is included in API's survey.

Semichemical corrugating medium capacity growth will be lower than kraft linerboard growth rates because of the increased use of recycled corrugating medium. Semichemical capacity will increase only 226,000 tons over the next three years, with growth averaging 1.3% a year.

In the period 1991-93, the startup of a new bleached paperboard machine by Westvaco Corp. and machine improvement projects by other companies will add 670,000 tons of new solid bleached sulfate (SBS) capacity and result in a 4.6% annual rate of increase. API reduced SBS capacity estimates in 1990 to account for Champion International's conversion of a machine to printing and writing grades as well as the conversion to printing bristol boards and bleached market pulp by other producers.

NEW MILLS AND PAPER MACHINES ANNOUNCED FOR U.S.

Company	Location	Project	Grade	Capacity (tpy)
Started up in 1990				
Boise Cascade	International Falls, Minn.	New machine	Uncoated free-sheet	300,000
Champion International	Quinnesec, Mich.	New machine	Coated free-sheet	265,000
Chesapeake	Menasha, Wis.	New machine	Tissue	80,000
Consolidated Papers	Stevens Point, Wis.	New machine	Specialty coated	59,000
Gaylord Container	Bogalusa, La.	New machine	Unbleached kraft liner	355,000
Kimberly-Clark	Jenks, Okla.	New mill	Tissue	68,000
Longview Fibre	Longview, Wash.	New machine	Kraft paper	107,000
Mead	Mahrt, Ala.	New mill	Coated kraft paperboard	350,000
Scott/Warren	Skowhegan, Maine	New machine	Coated free-sheet	215,000
Willamette Industries	Bennettsville, S.C.	New mill	Uncoated free-sheet	200,000
For 1991 startup				
Alabama Pine Pulp	Perdue Hill, Ala.	New mill	Bleached kraft pulp	468,500
Alabama River Newsprint	Claiborne, Ala.	New mill	Newsprint	243,000
Consolidated Papers	Wisconsin Rapids, Wis.	New machine	Coated free-sheet	212,000
Fort Howard	Rincon, Ga.	New machine	Tissue	88,500
Fox River Fiber	Kaukauna, Wis.	New mill	Deinked pulp	71,000
Georgia-Pacific	Ashdown, Ark.	New machine	Uncoated free-sheet	325,000
Kieffer Paper	Brownstown, Ind.	New mill	Deinked pulp	39,000
Kimberly-Clark	Loudon, Tenn.	New mill	Tissue	34,000
Mi Ho Paper	St. Joseph, Mo.	New mill	Uncoated free-sheet	123,000
North Pacific	Longview, Wash.	New machine	Recycled newsprint	254,000
Parsons & Whittemore	Claiborne, Ala.	New mill	Bleached kraft pulp	468,500
Union Camp	Savannah, Ga.	New machine	Unbleached kraft liner	175,000
Union Camp	Eastover, S.C.	New machine	Uncoated free-sheet	290,000
For 1992 startup				
Campbell Management	Gaffney, S.C.	New mill	Recycled linerboard	88,500
Federal Paper Board	Augusta, Ga.	New machine	Bleached bristols	233,500
International Paper	Selma, Ala.	New machine	Uncoated free-sheet	n.a.
Kenaf Paper	Raymondville, Texas	New mill	Newsprint	33,000
Potlatch	Lewiston, Idaho	New machine	Tissue	38,600
Shelby Tissue	Memphis, Tenn.	New mill	Recycled tissue	35,500
Jefferson Smurfit	Fernandina Beach, Fla.	New machine	Linerboard	n.a.

Continued

NEW MILLS AND PAPER MACHINES ANNOUNCED FOR U.S. (continued)

Company	Location	Project	Grade	Capacity (tpy)
For 1993 startup				
American Power	Barrackville, W. Va.	New mill	Deinked pulp	142,500
Boise Cascade	Rumford, Maine	New machine	Coated groundwood	318,000
Caithness King	Pejepscot, Maine	New mill	Deinked pulp	196,000
Formosa Chemicals	Wallace, La.	New mill	Dissolving pulp	704,000
Fort Howard	Green Bay, Wis.	New machine	Tissue	n.a.
Inland Container	Maysville, Ky.	New mill	Recycled containerboard	212,500
James River	Old Town, Maine	New machine	Recycled tissue	n.a.
Ponderosa Fibres	New York, N.Y.	New mill	Recycled newsprint	108,000
Procter & Gamble	Two undetermined	New machines	Tissue	n.a.
Scott Paper	Owensboro, Ky.	New mill	Tissue	n.a.
Westvaco	Covington, Va.	New machine	Bleached paperboard	350,000
For 1994 startup				
Evergreen	Redrock, Ariz.	New mill	Recycled newsprint	253,500
International Paper	Selma, Ala.	New machine	Uncoated free-sheet	300,000
Proposed projects (no startup date announced)				
Champion	Courtland, Ala.	New machine	Uncoated free-sheet	240,000
Daishowa	Port Angeles, Wash.	New machine	Newsprint	247,000
Dunkirk Paperboard	Dunkirk, N.Y.	New mill	Recycled containerboard	250,000
Federal Paper Board	Augusta, Ga.	New machine	Uncoated free-sheet	231,500
Fort Howard	Muskogee, Okla.	New machine	Tissue	n.a.
Fort Howard	Rincon, Ga.	New machine	Recycled tissue	88,500
Gulf States Paper	Demopolis, Ala.	New machine	Bleached paperboard	n.a.
James River	Pennington, Ala.	New machine	Tissue	n.a.
Mead	Northampton, Pa.	New mill	Recycled board	300,000
Northampton Paperboard	Northampton, Pa.	New mill	Recycled paperboard	212,000
Procter & Gamble	Oxnard, Calif.	New machine	Tissue	n.a.
Riverwood	West Monroe, La.	New machine	Unbleached kraft boxboard	
Jefferson Smurfit	Unspecified, N.Y.	New mill	Recycled newsprint	276,000
Westbrook	Klamath Fall, Ore.	New mill	Uncoated groundwood	n.a.
Weyerhaeuser	Springfield, Ore.	New machine	Unbleached kraft liner	178,500

n.a. = Not available.
Source: *Pulp & Paper Project Report.*

INDEFINITELY IDLED PULP AND PAPER MILLS IN U.S.

Company	Mill	Grade
Boise Cascade	Brownville, N.Y.	Recycled paperboard
Clinch River	Harriman, Tenn.	Corrugating medium
Contoocook Paper	West Henniker, N.H.	Latex-saturated papers
CPM	Claremont, N.H.	Specialty papers
Crown Paper Board	Philadelphia, Pa.	Recycled paperboard
Deerfield Specialty Papers	Monroe Bridge, Mass.	Specialty papers
Doeskin	Clayville, N.Y.	Tissue
Erving Paper Mills	Lockland, Ohio	Specialty papers
Evers Paper	Utica, N.Y.	Recycled paperboard
Falls Tissue	Mechanic Falls, Maine	Tissue
Georgia-Pacific	Reading, Pa.	Specialty papers
Hercules	Hopewell, Va.	Cotton pulp
Hinsdale Products	Hinsdale, N.H.	Tissue
Keyes Fibre	Shawmut, Maine	Groundwood pulp
Linweave	Holyoke, Mass.	Fine papers
Nicolet	Ambler, Pa.	Gasket board
Nicolet	Norristown, Pa.	Asbestos paper
Nickal Paper	Kalamazoo, Mich.	Recycled linerboard
Packaging Corp. of America	Middletown, Ohio	Molded pulp
Pennsylvania General	Buck Run, Pa.	Tissue
Performance Papers	Kalamazoo, Mich.	Specialty papers
Ponderosa St. Lawrence	Ogdensburg, N.Y.	Deinked market pulp
Procter & Gamble	Cheboygan, Mich.	Tissue
Riegel Div., James River	Riegelsville, N.J.	Specialty papers
Simpson	Middletown, Ohio	Specialty papers
Skybel Tissue Mills	Greenwich, N.Y.	Tissue
Sonoco Products	Richmond, Calif.	Recycled paperboard
Specialty Paperboard	Beaver Falls, N.Y.	Groundwood pulp
Texcrom Paper	Chambersburg, Pa.	Kraft toweling
Vermont Tissue	North Bennington, Vt.	Tissue
Warrensburg Board & Paper	Warrensburg, N.Y.	Corrugating medium
Whippany Paper Board	Whippany, N.J.	Recycled paperboard

Source: *1991 Lockwood-Post's Directory.*

PAPER AND PAPERBOARD CAPACITY REDUCTIONS

	Number of paper machines shut down[1]				Number of paper mills shut down[1]			
	1971-75	1976-80	1981-85	1986-93e	1971-75	1976-80	1981-85	1986-93e
Paper								
Newsprint	—	3	5	—	—	1	—	—
Printing/writing	51	32	38	35	8	5	4	7
Packaging/industrial converting	35	32	31	15	8	7	7	4
Tissue	6	25	30	15	4	8	13	5
Paperboard								
Unbleached kraft	2	2	5	3	—	1	—	—
Solid bleached	1	2	—	2	—	1	—	—
Semichemical	3	4	7	4	1	1	2	—
Recycled	29	35	18	6	14	12	12	3
Total paper and board[2]	**127**	**135**	**134**	**80**	**35**	**36**	**38**	**19**
Average rate/year	25	27	27	16	7	7	8	4

e = Estimate.
1. Includes machines converted to other grades.
2. Excludes construction grades.
Source: American Paper Institute.

PAPER AND PAPERBOARD CAPACITY REDUCTIONS

(000 short tpy)

	1971-75	1976-80	1981-85	1986-93e
Paper				
Newsprint	—	231	360	—
Printing/writing	803	550	771	572
Packaging/industrial converting	290	395	821	555
Tissue	52	246	308	167
Paperboard				
Unbleached kraft	128	400	742	602
Solid bleached	33	162	—	142
Semichemical	123	178	553	455
Recycled	872	1,295	644	118
Total paper and board[1]	**2,301**	**3,457**	**4,199**	**2,069**
Average rate/year	460	691	840	414

e = Estimate.
1. Excludes construction grades.
Source: American Paper Institute.

United States:

MERGERS AND ACQUISITIONS

Although mergers and acquisitions have been around since the beginning of business, the 1980s will be remembered as a decade in which M&A became a full-fledged business in its own right. Corporate raiders were, in many cases, able to turn a quick profit by breaking up acquired companies and divesting business units individually. Moreover, spurred by the tax deductibility of interest expense, many corporations were eager to participate, and "economies of scale" and "synergy" became buzzwords in the executive suite as well as on Wall Street. Companies, meanwhile, worried about being on the receiving end, were busy developing takeover defenses, including poison pills and preemptive asset sales.

The paper industry was no stranger to this game. Financiers such as Sir James Goldsmith and the Belzberg brothers were among the more aggressive corporate raiders. And although not initiators of hostile bids, companies such as Stone Container Corp., Jefferson Smurfit Corp., and James River Corp. put together paper empires by, in part, picking up pieces of companies "put into play." These firms saw acquisitions as a particularly alluring route to expansion, since acquisitors were typically able to purchase assets at a fraction of replacement cost and could increase market share without deluging the supply-sensitive market with new capacity and thereby compromising pricing. Between 1983 and 1987, nine top industry producers—Container Corp. of America, Continental Forest Industries, Crown Zellerbach Corp., Hammermill Papers, Jacksonville Kraft Co., Owens-Illinois Inc.'s Forest Products Group, Publishers Paper Co., St. Regis Paper Co., and Southwest Forest Industries Inc.—were gobbled up by the competition. And in mid-1988, officers at Fort Howard Corp., possibly in a move to preempt unwelcome advances by outsiders, headed a record $3.96-billion, management-led leveraged buyout (LBO). About 15 months later, Fort Howard paid off a sizable chunk of debt following the $532-million sale of its U.S. and Canadian cup operations to Sweetheart Holdings Inc., a new company controlled by the Morgan Stanley Leveraged Equity Fund II and a private investor group. But the biggest deal of 1989, signed in March, was Stone Container's $2.7-billion acquisition of Consolidated-Bathurst Inc.

By this time, however, the climate for takeovers was becoming less favorable as the junk bond market slipped into disarray and a seemingly endless era of paper industry prosperity began to wear around the edges. M&A activity slowed but did not grind to a halt. In March 1990, Georgia-Pacific Corp. completed what was the first (major) hostile takeover by a U.S. paper company with the acquisition of industry rival Great Northern Nekoosa Corp. Certain observers expected G-P's move to prompt a series of major acquisitions or mergers. But the downturn in the economy and concomitant squeezing of paper industry cash flows appear to have at least delayed this process.

A HOSTILE MOVE

Georgia-Pacific's chairman, T. Marshall Hahn Jr., put his friendship with Great Northern Nekoosa chairman William Laidig and much more on the line when G-P announced in October 1989 that it would seek to acquire GNN for $63/share. Laidig derided the $63/share bid as inadequate, and GNN filed a motion in Maine's U.S. District Court seeking an injunction against G-P's tender offer. Maine's attorney general then filed an antitrust lawsuit against G-P, although the U.S. Federal Trade Commission (FTC) had already ruled that the union of the two firms would not be a problem. When this tack proved to be of no avail, GNN concluded that it would be unable to survive this ordeal as an independent firm and sought rescue by a "white knight." But no third party stepped forward to intervene, and GNN's management finally agreed to support the merger in February 1990 after G-P had raised its cash tender offer to $65.75/share. When all was said and done, the total amount required to purchase GNN's stock and pay related fees was approximately $3.7 billion. G-P also assumed GNN's $1.7 billion of debt. The combination created a firm that was, for the moment, the world's largest forest products company, with pro forma annual sales of roughly $14 billion.

The addition of GNN's operations augmented G-P's leading positions in several markets, including uncoated printing/writing papers, market pulp, containerboard, and corrugated boxes, as well as added three new businesses: groundwood papers (for the time being), paper distribution, and envelopes. It also saddled G-P with a massive debt load topping $6.5 billion, or 64% of total capital, as of Mar. 31, 1990. The company quickly made clear that the paydown of borrowings was to be a priority, stating that it would seek within three years to lower its debt-to-capital ratio to the 40% to 45% range that existed before the merger.

At the operating level, Georgia-Pacific announced it would try to squeeze $160 million to $180 million in savings out of synergies and economies of scale. Even so, it was apparent that the company would need to do much more than this to get its balance sheet back in order.

Accordingly, G-P quickly turned to the sale of assets, and by early 1991, the company had generated more than $1 billion through divestments. These included interests in several European paper operations and timberland as well as a complex $740-million deal in which Packaging Corp. of America, a unit of Tenneco Inc., gained operating control of 19 box plants, the Valdosta, Ga., linerboard mill, and the Tomahawk, Wis., semichemical medium mill. About 540,000 acres of G-P timberland were also involved in this agreement. (The assets were actually acquired by GE Capital and leased back to PCA in one of the largest transactions of this kind undertaken in the paper industry.) This deal, coupled with the purchase of Dixie Container Corp., a Virginia-headquartered operator of three corrugator plants, three sheet plants, and a recycled medium mill, transformed PCA from a mid-size containerboard player to about the fifth largest in the industry, with capacity of more than 1.8 million tpy and a total of 56 corrugated packaging plants.

Then in October 1991, after a lengthy courtship, G-P announced a preliminary agreement with Bowater Inc., in which the latter would pay $300 million in cash for an 80% interest in the former Great Northern newsprint and groundwood paper mills in Millinocket and East Millinocket, Maine. Also included in the deal would be hydroelectric assets powering the mills, a lumber plant, and about 2.1 million acres of associated timberland. Completion of the Bowater sale was dependent upon approval by appropriate federal and state regulatory agencies but was expected to take place by the end of 1991.

Under the agreement, Bowater will manage Great Northern Paper and also have the option to purchase the remaining 20% interest for $22 million. The agreement gives G-P the right to require Bowater to make that purchase after June 30, 1992. Bowater said the purchase agreement grew out of joint development studies of the former GNN properties announced by Bowater and G-P in December 1990. Bowater said it will proceed with previous plans to install a recycling deinking plant for newspaper and directory papers at East Millinocket, something Great Northern Paper had been planning for some time.

Assuming completion of this acquisition, Bowater, which is the sixth largest North American producer of coated groundwood (with about 345,000 tpy of lightweight coated paper capacity—about 6.3% of total industry capacity), would move to near the top of the North American coated groundwood capacity list. The acquisition of GNP would also strengthen Bowater's position as the largest U.S. newsprint supplier and would move it into third place in North America, with combined capacity of about 1.3 million short tons (based on equity ownership). It would also represent a major entry for the company into uncoated groundwood papers.

The purchase will be financed through external sources, said Bowater, which as of June 1991 had total debt of $533 million, for a relatively conservative total debt-to-capital ratio of about 25%. Based on current figures, the GNP deal would raise the debt-to-capital ratio to around 34%, which is roughly the industry average.

IP seeks distributors and foreign operations. International Paper Co. has also been active on the acquisition front, despite the industry's cyclical downturn. Most recently, IP has been showing a piqued appetite for distribution operations. In March 1990, IP added western distribution capacity through its purchase of Dixon Paper Co., a Denver, Colo.-based merchant with 1989 sales of about $250 million. Then in early 1991, IP bought Dillard Paper Co. of Greensboro, S.C., whose sales of $500 million filled a gap in IP's distribution business in the Southeast. Next, in June 1991, IP purchased its second paper merchant of the year with the acquisition of Leslie Paper, a Minneapolis, Minn.-based printing and industrial paper distributor that recorded 1990 sales of almost $400 million. Leslie's operations strengthen IP's position in the Midwest and complement existing operations in the Southwest. Following this series of acquisitions, IP's distribution business, which also includes Hammermill Papers, Carter Rice, Arvey Paper, Reliable Paper Co., Western Paper Co., and Harrisburg Paper Co., has an annual revenue base of nearly $3 billion, making it the second largest paper distributor in the industry behind Alco Standard.

International Paper has also been busy putting money where its name is. In 1989, IP bought Aussedat Rey SA, a leading French fine papermaker, for Fr2.03 billion, and in 1989-90, the company acquired control of Zanders Feinpapiere AG, a leading West German paper firm. IP now derives about one-third of its sales from abroad. Other European purchases in the late 1980s included Anitec Image Technology Corp., a maker of photosensitive papers and films for the commercial printing industry, and Ilford Group, a U.K.-based manufacturer of photographic films and papers.

Since the turn of the decade, IP has remained active. In late 1990, the company, citing an expansion strategy in the graphic arts, purchased the Cookson Graphics business from Britain's Cookson Group plc for $215 million (Cookson Graphics supplies lithographic printing plates, pressroom chemicals, and plate-processing equipment to the commercial printing industry, with plants in the U.K., Ger-

MAJOR ACQUISITIONS INVOLVING U.S. PULP AND PAPER MILL ASSETS

Acquiring company	Assets purchased	Estimated value (million $)	Year effective
Bowater Inc.	Georgia-Pacific Corp., Great Northern mills (80% share)	$300	1991
James River Corp.	Riverwood International Corp., consumer packaging plant[1]	n.a.	1991
Encore Paper Co.	James River Corp., towel/tissue mill	n.a.	1991
Simkins Industries Inc.	Harvard Folding Box, Ideal Box, folding carton plants	n.a.	1991
Sealed Air. Corp.	Sentinel Holdings Inc., protective packaging products	10.3	1991
Coastal Paper Co.	James River Corp., carbonizing tissue mill	n.a.	1991
Willamette Industries Inc.	Bohemia Inc., timber and wood products	122	1991
Ralston Purina Co.	James River Corp., specialty cellulose business	n.a.	1991
Mr. Merritt Sorenson	Big M Paperboard Inc. mill	n.a.	1991
Constantia AG	Boise Cascade Corp., 50% interest in Duropack (Austria)	50	1991
Merrimac Paper Co.	James River Corp., specialty paper mill	n.a.	1991
Associated Stationers Inc.	Boise Cascade Corp., wholesale office products unit	n.a.	1991
International Paper Co.	Leslie Paper Co., distributor	n.a.	1991
Fox River Paper Co.	Howard Paper Mills, two specialty paper mills	n.a.	1991
Oak Tree Packaging Corp.	Federal Paper Board Co. Inc., three folding carton plants	n.a.	1991
Rock-Tenn Co.	Ellis Paperboard Products Inc., folding carton plants	n.a.	1991
Liberty Carton Co.	Northern Package Corp., box plant	n.a.	1991
Rock-Tenn Co.	Specialty Paperboard Inc. mill	n.a.	1991
Specialty Coatings Group	James River Corp., 22 specialty papers mills	337	1991
APC Paper Co.	CPM Inc., specialty papers mill	n.a.	1991
International Paper Co.	Dillard Paper Co., distributor	n.a.	1991
Kruger Inc.	Manistique Papers Inc.	n.a.	1991
Ivex Corp.	Detroit River Paper Co.	n.a.	1991
LA-PRI Paper Corp.	Elcor Corp., idle recycled paperboard mill	n.a.	1991
Recovery Equity Partners L.P.	Watervliet Paper Co., C.A. Hubbard Paper Co.	1.6	1991
American Industrial Partners	San Joaquin Packaging Corp., Fidelity Packaging	n.a.	1991
Sealed Air Corp.	Georgia-Pacific Corp., Hopper Paper mill	n.a.	1991
Premier Packaging	Chesapeake Corp. packaging plant	n.a.	1991
Southern Bag Corp. Ltd.	Georgia-Pacific Corp. multiwall bag plants	n.a.	1991
Four M	Garden State Container Corp., Service Container Corp.	n.a.	1991
Jefferson Smurfit Corp.	Boise Cascade Corp., two corrugated plants	n.a.	1991
Union Camp Corp.	Chase Packaging Corp., specialty bags plant	84.1	1990
Simpson Paper Co.	James River Corp., publishing papers mill	66.7	1990
Manville Forest Products Corp.	Federal Paper Board Co. Inc., packaging machinery unit and folding carton plant	100[2]	1990
Field Container Corp.	Federal Paper Board Co. Inc., four folding carton plants	n.a.[2]	1990
Mitsubishi Corp., Tomoku Co. Ltd.	Longview Fibre Co., box plant	n.a.	1990
Tenneco Inc. (PCA)	Dixie Container Corp.	n.a.	1990
Tenneco Inc. (PCA), GE Capital	Georgia-Pacific Corp., 19 corrugated box plants, Valdosta, Ga., liner mill, and Tomahawk, Wis., medium mill	740	1990
Addington Enviromental Inc.	Clinch River Corp.'s bankrupt Harriman, Tenn., paperboard mill (bid withdrawn Jan. 1991)	4.8	1990
Federal Paper Board Co. Inc.	Continental Bondware	146.5	1990
Inland Container Corp.	Crockett Container Corp., Pakway Container Corp.	n.a.	1990
Rock-Tenn Co.	Allforms Packaging Corp., Box Innards Inc.	n.a.	1990
Jefferson Smurfit Group	Golden State Newsprint Co. Inc., Pacific Recycling Co.	95	1990
Jefferson Smurfit Corp.	Keystone Container Corp., corrugated sheet plant	n.a.	1990
International Paper Co.	Dixon Paper Co., wholesaler and distributor	n.a.	1990
Amcor Ltd.	Completed purchase of Sunclipse Inc.	105	1990
Georgia-Pacific Corp.	Great Northern Nekoosa Corp.	3,740	1990
Willamette Industries Inc.	Penntech Papers Inc.	72	1990
Holzstoff Holding AG	James River Corp. Nonwovens Group	175	1990
Yorktowne Paper Mills Inc.	Columbia Corp., two recycled paperboard mills	n.a.	1990
Union Camp Corp.	Tate Containers Inc., corrugated box plant	n.a.	1990
Ponderosa Fibres	Tomahawk Tissue Corp.'s idle mill	n.a.	1990

Continued

MAJOR ACQUISITIONS INVOLVING U.S. PULP AND PAPER MILL ASSETS (continued)

Acquiring company	Assets purchased	Estimated value (million $)	Year effective
SIBV/MS Holdings Inc.	Jefferson Smurfit Corp./Container Corp. of America	$1,584	1989
Federal Paper Board Co.	Imperial Cup Corp.	114	1989
Sweetheart Holdings Inc.	Fort Howard Corp.'s U.S. and Canadian cup operations	532	1989
Berkshire Hathaway Inc.	8% stake in Champion International Corp.	300	1989
Arcadia Partners L.P.	Ivex Corp.'s three specialty papers mills	n.a.	1989
Warrior River Paper Co.	Howard Paper Mills Inc.'s two printing/writing paper mills	n.a.	1989
Newark Group	Gold Bond Building Products' recycled board mill	n.a.	1989
Kapaco Group	Watervliet Paper Co.'s Watervliet, Mich., specialty papers mill	n.a.	1989
Investor group	APL Corp.'s tissue business	50	1989
Giant Group Ltd.	Garden State Paper Co.'s Pomona, Calif., newsprint mill	56	1989
Preco Corp.	E.B. Eddy's Brewer, Maine, fine paper mill	n.a.	1988
Fairfield Paper Co.	Gaylord Container Corp.'s Baltimore, Ohio, containerboard mill	17	1988
FH Acquisition	Management's leveraged buyout of Fort Howard Paper Co.	3,962	1988
James River Corp.	23% of Diamond Occidental's common stock	25	1988
Settsu Corp.	9.6% stake in USG Corp.	35.5	1988
Caraustar Industries Inc.	USG Corp.'s Camden, N.J., gypsum linerboard mill	n.a.	1988
Valley Converting Co.	Toronto Paperboard Corp.'s recycled board mill	n.a.	1988
Newark Group	Federal Paper Board Co.'s Los Angeles, Calif., recycled board mill	n.a.	1988
Georgia-Pacific Corp.	Brunswick Pulp & Paper Co.	665	1988
Daishowa America Co. Ltd.	Port Angeles, Wash., groundwood paper mill from James River	75	1988
Gaylord Container Corp.	Fibreboard Corp. containerboard assets from Louisiana-Pacific Corp.	156	1988
Kapaco Group	Pentair Inc.'s Detroit, Mich., specialty papers mill	n.a.	1988
Rock-Tenn Co.	Mead Corp.'s recycled paperboard businesses	65	1988
E.B. Eddy Forest Products Ltd.	Port Huron Paper Corp. from Pentair	n.a.	1987
P.H. Glatfelter Co.	Ecusta Corp.	219	1987
Great Northern Nekoosa Corp.	Forest Products Group of Owens-Illinois Inc.	1,170	1987
James River Corp.	Dunn Paper Co. from Dennison Manufacturing	n.a.	1987
Mead Corp.	Georgia Kraft Co. mill in Phenix City, Ala.; part of reorganization and termination of joint venture with Temple-Inland	n.a.	1987
Pope & Talbot Inc.	Ransom, Pa., tissue mill from Potlatch	27	1987
Pratt Holdings Pty Ltd.	Georgia Kraft Co. linerboard mill and related assets in Macon, Ga.	272	1987
Simkins Industries Inc.	Deerfield Specialty Papers from Reed Holdings Inc.	n.a.	1987
Simpson Paper Co.	Pasadena, Texas, free-sheet paper mill of Champion International Corp.	90	1987
Simpson Paper Co.	Plainwell Paper Co. from Chesapeake Corp.	n.a.	1987
Smorgon Consolidated Industries Pty Ltd.	FSC Paper Corp. from Media General and Interstate Holdings	n.a.	1987
Stone Container Corp.	Southwest Forest Industries	760	1987
Stora Kopparberg Group	40% of Mohawk Paper Mills	24	1987
Temple-Inland Inc.	Owens-Illinois' Orange, Texas, linerboard mill	228	1986
Settsu Corp.	21% of Caraustar Industries Inc.	n.a.	1986
Boise Cascade Corp.	Jackson, Ala., mill of Allied Paper Inc.	150	1986
China National Packaging Corp.	Morris Paper Board mill in Paterson, N.J.	n.a.	1986
GC Acquisition Corp.	Gaylord Container, spun off during James River's acquisition of Crown Zellerbach	260	1986
Hanson Trust plc	Allied Paper Inc. from SCM Corp.	n.a.	1986
International Paper Co.	Hammermill Paper Co.	1,441	1986
JFC-MS Holdings Inc.	Container Corp. of America from Mobil Corp.	1,139	1986
James River Corp.	Crown Zellerbach Corp. pulp and paper operations	1,428	1986
James River Corp.	Premoid Group from Preco Corp.	n.a.	1986
Rand-Whitney Packaging Corp.	Montville, Conn., boxboard mill from Robertson Paper Box	n.a.	1986
Seminole Kraft Corp.	Jacksonville Kraft Paper Co.	112	1986
Jefferson Smurfit Corp.	80% of Publishers Paper Co. from Times Mirror Inc.; included two newsprint mills	132	1986
Stone Container Corp.	Most of the packaging operations of Champion International	426	1986
Temple-Inland Inc.	Linerboard mill at Orange, Texas, from Owens-Illinois	228	1986

Continued

many, and the U.S. and annual sales of about $300 million). Following the acquisition, IP's imaging products sales approach $1 billion. Then in early 1991, IP outbid Jefferson Smurfit Group plc for Georgia-Pacific's corrugated packaging operations in France. The $105-million acquisition of Laurent-Esplay, which G-P acquired in the GNN takeover, and of Papeteries Etienne provided IP with 13 corrugated converting plants in Europe.

Restructuring efforts. Other major firms have been more intent on downsizing and honing their focus (rather than expanding through acquisition) during the difficult market conditions of the early 1990s. A case in point is James River, one of the paper industry's acquisition success stories of the 1980s. James River, which began as a one-mill operation in 1969, grew rapidly by purchasing assets divested by companies leaving the industry or sold off after takeovers. For instance, in 1980, when Gulf + Western Industries sold its controlling interest in Brown Co. to

MAJOR ACQUISITIONS INVOLVING U.S. PULP AND PAPER MILL ASSETS (continued)

Acquiring company	Assets purchased	Estimated value (million $)	Year effective
Texcrom Paper Corp.	Chambersburg, Pa., tissue mill from United Paper Mills	n.a.	1986
Mid-America Packaging Inc.	Weyerhaeuser Co.'s Pine Bluff, Ark., containerboard mill	$28	1985
Federal Paper Board Co.	Continental Group's Augusta, Ga., bleached board mill	305	1985
Carlyle Investments	Hennepin Paper Co. from Champion International, and Pejepscot Paper Co. from Hearst Corp.	n.a.	1985
Chesapeake Corp.	Wisconsin Tissue Mills and Plainwell Paper from Philip Morris Inc.	210	1985
Ecusta Corp.	Purchased in leveraged buyout from Olin Corp.	130	1985
Hammermill Paper Co.	Nicolet Paper Co. from Philip Morris Inc.	n.a.	1985
International Paper Co.	Durham Mills Inc.'s recycled paperboard mill at Riegelsville, Pa.	n.a.	1985
Lyons Falls Pulp & Paper Inc.	Lyons Falls, N.Y., mill of Georgia-Pacific	n.a.	1985
Petratex Paper Co. Inc.	Specialty kraft paper mill of Bemis Co. at Peoria, Ill.	n.a.	1985
Simpson Paper Co.	Tacoma, Wash., kraft paper mill of Champion International	27	1985
Trident Associates	Two recycled paperboard mills and six folding carton plants from Champion International	n.a.	1985
Appleton Papers Inc.	Glatfelter's West Carrollton, Ohio, mill	83	1984
Boise Cascade Corp.	Sonat's 50% interest in Boise Southern	195	1984
Bowater Inc.	Bowater Corp.'s North American assets	123	1984
Caraustar Industries Inc.	Three Container Corp. of America recycled paperboard mills	n.a.	1984
Champion International Corp.	St. Regis Corp.	2,538	1984
Georgia-Pacific Corp.	Monticello, Miss., linerboard mill and related assets from St. Regis	375	1984
Peter Kiewit Sons	Continental Group Inc.	2,785	1984
Stora Kopparberg Group	Newton Falls Paper Mill	n.a.	1984
Temple-Inland Inc.	Temple-Eastex and Inland Container spun off by Time Inc.	n.a.	1984
Boise Cascade Corp.	Saxon's Missisquoi specialty paperboard mill	n.a.	1983
Haindl Paper Co.	Crown Zellerbach's Port Townsend, Wash., unbleached kraft paper mill	n.a.	1983
Jacksonville Paper Co.	St. Regis kraft paper mill	n.a.	1983
James River Corp.	American Can's Marathon, Ont., pulp mill	n.a.	1983
James River Corp.	Diamond International's pulp and papermaking assets	171	1983
Mosinee Paper Corp.	Sorg Paper Co.	18	1983
Pope & Talbot Inc.	American Can's 50% interest in Halsey, Ore., pulp mill	14	1983
Republic Gypsum Co.	Two PCA recycled boxboard mills	n.a.	1983
Stone Container Corp.	Major portion of Continental Forest's Brown System	510	1983
Technographics Inc.	Litton Industries, including Fitchburg Paper	70	1983
James River Corp.	Most of the assets of American Can Co.	446	1982
Jefferson Smurfit Ltd.	Diamond International Corp.'s paperboard, converting, and printing businesses	80	1982
Sir James Goldsmith	Acquired Diamond International Corp.	455	1982
Jefferson Smurfit Group Ltd.	Alton Box Board Co.	n.a.	1981
James River Corp.	Brown Co.	172	1980
Johns-Manville Corp.	Olinkraft Inc.	n.a.	1979

n.a. = Not available.

1. Formerly Manville Forest Products Corp.

2. Value of divestments to Federal Paper Board Co. Inc. from both agreements.

James River and Pope & Talbot Inc., James River got most of Brown's pulp and paper operations and some timberland. After that deal, JR more than doubled its size with the 1982 purchase of American Can's paper-industry assets for $446 million. This further integrated James River into pulp production and made it a major national producer of tissue and folding cartons. Then in 1983, the company paid $172 million for Diamond International's pulp and papermaking assets, adding to its white papers capacity and extending its tissue and towel business in the Northeast. Also that year, Phillips Petroleum Co. sold its H.P. Smith Paper Co. unit to JR for $34.5 million. The 1986 purchase of most of Crown Zellerbach's papermaking operations in a stock swap valued at about $1.43 billion propelled JR into becoming one of the top five companies in the industry. The company also expanded in the international market, particularly in Europe, with the 1987 purchase of 50% of the Kaysersberg Div. of French papermaker Beghin-Say for $243 million. This purchase was followed in 1989 by the $77-million acquisition of the tissue operations of Bührmann-Tetterode NV of the Netherlands, which were to be part of a joint venture with Nokia Corp. of Finland and Gruppo Ferruzzi of Italy.

However, some analysts criticized the resulting James

FOREIGN OWNERSHIP OF U.S. PULP AND PAPER COMPANIES

Company	% owned	Foreign owner	Assets
Alaska Pulp Corp.	100%	Alaska Pulp Co., Japan of Hanson Trust, U.K.	Market pulp mill, Sitka, Alaska
American Fibrit	100	Deutsch Fibrit, West Germany	Molded pulp products mill, Battle Creek, Mich.
Appleton Papers Inc.	100	Wiggins Teape Appleton plc, U.K.	Pulp/paper mills, West Carrollton, Ohio; Roaring Springs, Pa.; Combined Locks, Wis.
Alabama River Newsprint	50	Abitibi-Price Inc., Canada	Newsprint mill, Claiborne, Ala.
Augusta Newsprint Co.	50	Abitibi-Price Inc., Canada	Newsprint mill, Augusta, Ga.
Blandin Paper Co.		Fletcher Challenge Canada Ltd.	Coated groundwood mill, Grand Rapids, Minn.
Caraustar Industries Inc.	22	Settsu, Japan	About ten paperboard mills in South and Midwest
Cascades Industries Inc.	100	Cascades Inc., Canada	Tissue/toweling mill, Rockingham, N.C.
Cascades Niagara Falls	100	Cascades Inc., Canada	Recycled corrugating medium mill, Niagara Falls, N.Y.
Daishowa America Co. Ltd.	100	Daishowa International, U.S. subsidiary of Daishowa Paper Mfg., Japan	Paper mill, Port Angeles, Wash.
E.B. Eddy Paper Inc.	100	E.B. Eddy Forest Products Ltd., Canada	Lightweight coated paper mill, Port Huron, Mich.
Fraser Paper Ltd.	100	Fraser Inc., Canada	Printing/writing paper mill, Madawaska, Maine
FSC Paper Co.	100	Smorgon Consolidated Industries, Australia	Deinked pulp/newsprint mill, Alsip, Ill.
Groveton Paper Board Inc.	69	SPB Canada, Canada	Paperboard mill, Groveton, N.H.
Hollingsworth & Vose Co.	100	Hollingsworth & Vose Co. Ltd., U.K.	Four specialty paper mills
Jefferson Smurfit Corp.	100	Jefferson Smurfit Group, Ireland	diverse paper and board operations
Keyes Fibre	100	Royal Packaging Industries, Van Leer, Netherlands	Six molded pulp products mills
MacMillan Bloedel Inc.	100	MacMillan Bloedel Ltd., Canada	Containerboard mill, Pine Hill, Ala.
Macon Kraft Inc.	100	Pratt Holdings, Australia	Linerboard mill, Macon, Ga.
Madison Paper	60	Myllykoski, Finland	Pulp/paper mill, Madison, Wis.
Manistique Papers Inc.	100	Kruger Inc., Canada	Newsprint, groundwood mill, Manistique, Mich.
Midtec Paper Co.	100	Repap Enterprises Corp., Canada	Coated papers mill, Kimberly, Wis.
Mohawk Paper Mills	40	Stora Group, Sweden	Paper mills, Cohoes and Waterford, N.Y.
Newton Falls Paper Mill	100	Stora Group, Sweden	Paper mill, Newton Falls, N.Y.
North Pacific Paper	20	Jujo Paper, Japan	Pulp/newsprint mill, Longview, Wash.
Ponderay Newsprint Co.	40	Lake Superior Forest Products Inc., subsidiary of Canadian Pacific Forest Products Ltd., Canada	Newsprint mill, Usk, Wash.
Port Townsend Paper Corp.	100	Haindl Papier, Fed. Rep. Germany	Pulp/paper/paperboard mill, Port Townsend, Wash.
PWA Rolland Decor	51 49	PWA Dekor GmbH, Germany Rolland Inc., Canada	Decorative papers mill, Fitchburg, Mass.
Schoeller Technical Papers	100	Felix Schoeller GmbH, Germany	Paper mill, Pulaski, N.Y.
Southland Box Co.	100	Mitsubishi Corp./Tomoku Co., Japan	Los Angeles, Calif., box plant
Visy Recycle Inc.	100	Pratt Holdings, Australia	Corrugating medium mill, Hartford City, Ind.

River as being unmanageable, suggesting that its nonintegrated mills were a liability and that the CZ mills made the company particularly vulnerable to rising wood costs in the Pacific Northwest. JR's management eventually responded, and in August 1990, the company undertook a massive restructuring effort to divest or close some 30 mills and converting plants representing $1.3 billion in sales, or about 20% of company capacity in the U.S. and the U.K. JR's plan was to focus its attention on its more profitable towels and tissue, Dixie food service products, food and consumer packaging, and communication papers businesses. The company indicated that as well as generating cash, the restructuring should provide cost benefits and reduced cyclicality by bringing domestic paper and fiber production into balance.

Among the properties sold since the divestment program began is the 485-tpd coated and uncoated printing and publishing papers mill in West Linn, Ore., which was purchased by Simpson Paper Co. for $66.7 million in December 1990 (Simpson originally planned to make recycled coated free-sheet paper at the mill, which it renamed the Evergreen Mill).

Early in 1991, JR sold its Nonwovens Group to Holzstoff Holding AG of Germany for $175 million in cash. James River also divested its specialty papers unit in 1991, selling the bulk of its operations to Specialty Coatings Group, which is controlled by AEA Investors Inc. and a management group headed by James E. Rogers, who was formerly group executive for JR's specialty papers business. The AEA/management purchase represented sales of approximately $700 million, or 54% of total assets included in JR's divestiture plans. JR retains a 20% interest in the new company.

Merrimac Paper Co. completed JR's exit from the specialty papers business in July by purchasing the Pepperell, Mass., mill. In August, JR completed the sale of its small Wiggins, Miss., carbonizing tissue mill to Coastal Paper Co., a joint venture of James River and William J. Van Devender of Jackson, Miss. In October, Encore Paper Co. bought JR's South Glens Falls, N.Y., commercial tissue and towel mill. Additionally, JR sold its Solka Floc specialty cellulose operation in Berlin, N.H., to Ralston Purina Co., and it still aims to sell mills in Gorham and Groveton, N.H., and a towel and tissue mill in Ashland, Wis.

Despite its willingness to unload a couple of small tissue mills, the company still intends to emphasize this grade, and on the strength of new machines and expansion projects, tissue capacity is to increase by 200,000 tpy during 1991. JR also intends to concentrate on coated groundwood papers and is planning incremental expansion at its St. Francisville, La., mill. In addition, JR enhanced its food and consumer packaging division by acquiring a folding carton plant in Charlotte, N.C., from Riverwood International Corp. JR plans to expand this plant as well as its Garden Grove, Calif., folding carton plant with new, state-of-the-art printing equipment.

Back to the divestment theme, James River plans to reduce its interest in the Marathon, Ont., pulp mill from 80% to 50% (Buchanan Forest Products Ltd. is JR's partner in the 500-tpd market pulp mill). The mill, in the meantime, is scheduled to complete a $280-million project designed to double pulp capacity in late 1991. As part of its restructuring plan, James River has also consolidated its food packaging papermaking operations at Milford, N.J., and Paramount and Port Huron, Mich., as well as the packaging paper products from St. Francisville and Camas.

Scott Paper Co. is another major player who announced an extensive restructuring effort in 1991, saying it intended to sell its Westbrook, Maine, specialty paper mill along with its nonwovens unit and 14 of 17 food-service-related facilities. Scott had earlier sold its interests in Brunswick Pulp & Paper, Washington State timberlands, and a Brazilian affiliate.

Carton plants galore. Folding carton plant sales were numerous in the U.S. in 1990 and 1991, with Federal Paper Board Co. Inc. selling off seven plants and its packaging machinery unit within six months. Field Container Corp. agreed to buy four plants from Federal but later decided it would lease one of those. Federal sold its Jet-et-Pak packaging machinery group to Manville Forest Products Corp., and through a management buyout, newly formed Oak Tree Packaging Corp. of Montvale, N.J., arranged to operate three of Federal's plants in the eastern U.S. Rock-Tenn Co. was also on the move, acquiring Ellis Paperboard Inc. of Scarborough, Maine, and its Canadian subsidiary, Dominion Paperboard Products Ltd. Rock-Tenn has been on an acquisition binge since purchasing Allforms Packaging Corp., Long Island, N.Y., and Box Innards Inc., Orange, Calif., in summer 1990.

In April 1991, Rock-Tenn completed the acquisition of Specialty Paperboard Inc., in Sheldon Springs, Vt., giving Rock-Tenn control of 60 manufacturing and distribution operations in the U.S., with total production capacity of 607,000 tpy of recycled paperboard products at ten mills. Jefferson Smurfit acquired several container plants in 1990 and two from Boise Cascade Corp. in early 1991.

LOOKING BACK AT THE EIGHTIES

In the early and mid-1980s, raiders made a lot of money toppling U.S. paper companies, whether through successful buyouts or sale of their shares to a higher bidder. Hostile takeover attempts came almost exclusively from raiders outside the pulp and paper industry. And although companies like James River and Stone Container did not initiate hostile bids themselves, they were quick to buy the assets of acquired companies. For example, in 1984, Jefferson Smurfit purchased a stake in Southwest Forest Industries (a producer of containerboard, newsprint, and market pulp) after a management-led LBO of SFI failed. But merger talks broke down quickly, and Smurfit agreed not to purchase SFI stock for ten years. Then less than two years later, SFI had to fend off another takeover attempt, this time by a group of Oklahoma oil and gas investors. SFI was finally purchased in 1987 in a friendly merger with Stone Container worth $760 million.

Potential takeover targets did not just sit around with their fingers crossed. Rather, the 1980s saw company managements scrambling to develop defensive measures to discourage unwanted takeover attempts. Some of these defenses aimed at making hostile takeovers more difficult by concentrating shares in the hands of friendly holders or by staggering directors' term. Others focused on preemptive measures, such as the sale of noncore or easily separable business units/assets.

Another approach, developed in 1984, is the poison pill, which gives special purchase rights to long-term shareholders (who are more likely to be supportive of management) in the event of a hostile takeover attempt. These rights generally allow those holders who have owned stock for a specified period of time to purchase shares at a steep discount once a new buyer has surpassed a certain threshold level of ownership—usually 20% to 30%. Crown Zellerbach and Owens-Illinois were the first in the paper industry to adopt poison pills, followed by Boise Cascade, Bowater, Great Northern Nekoosa, International Paper, Southwest Forest Industries, and Union Camp Corp. But as half of these eight companies can testify, none of these defenses is guaranteed.

Goldsmith heads list of raiders. Sir James Goldsmith, a British financier, has been perhaps the most aggressive corporate raider in the paper industry. Most recently, in late 1989, it was his $21-billion bid that led to the breakup of B.A.T Industries plc, a U.K.-based conglomerate. (In an effort to rebuff Goldsmith's bid, B.A.T spun off its paper, retail, and financial businesses. In the process, Wiggins Teape Group Ltd. and Appleton Papers Inc. were combined in a new, publicly held holding company run by management from the two firms.)

Earlier in the decade, Goldsmith's pursuit of undervalued companies with assets that could be divested easily as independent units had made him a fairly frequent suitor to the U.S. paper industry, including unsolicited offers for Diamond International Corp., Continental Group Inc., St. Regis, and Crown Zellerbach. All four companies, after being put into play, eventually lost their independence—two to Goldsmith and two to white knight purchasers.

Goldsmith's first major U.S. paper company target was Diamond International. After buying an initial 5.6% stake in late 1979 and accumulating stock gradually, Goldsmith completed the acquisition of the company in 1982. The total purchase price over the three-year period was about $660 million. Goldsmith then recouped his investment (plus an extra $200 million or so) by selling off Diamond's assets one division at a time. Among the divested operations were Diamond's paperboard, converting, and printing businesses, sold to Jefferson Smurfit for $80 million in 1982, and the company's papermaking assets, sold to James River for $170 million in 1983.

Goldsmith's next industry target was Continental Group, an insurance, energy, and packaging company and, at the time, the largest U.S. producer of bleached paperboard. After having purchased a 1% stake in Continental for about $15 million, Goldsmith offered $2.42 billion (or $50/share) for the remainder of the company. Continental's management rejected the offer and soon afterward agreed to a merger with a company owned 80% by Peter Kiewit & Sons and 20% by financier David Murdock's Murdock Investment Corp. That deal was worth $58.50/share, or about $2.79 billion. To help finance the acquisition, Kiewit-Murdock sold Continental's bleached paperboard mill at Augusta, Ga., and related assets to Federal Paper Board in early 1985 for $305 million. And as an interesting follow-up, five years later, Peter Kiewit's Continental Holdings Inc. sold its Continental Bondware business to Federal for $146.5 million. Bondware is a major producer of paper cups and disposable food-service products with annual sales, at the time, of $180 million. Bondware and Imperial Cup Corp., which was purchased in 1989 for $114 million, boosted integration of Federal's bleached paperboard mills.

Fight for St. Regis. St Regis was a third hapless target. In February 1984, an investor group led by Goldsmith bought an 8.6% stake in St. Regis, with the stated intent to take over the company eventually. A month later, however, Goldsmith and his group were willing to move back to the sidelines, settling for a little "greenmail," as St. Regis bought back the 8.6% stake, paying a substantial premium over its then-current stock price.

But the battle for St. Regis was just beginning. In May, the company sold its Monticello, Miss., linerboard mill and related assets to Georgia-Pacific for $342.5 million. Although a takeover defense may not have been the primary reason for the sale—St. Regis had been unhappy with its containerboard operations, it did serve to make the company less attractive to unwanted suitors. In addition, G-P became a friendly shareholder as part of the transaction, agreeing to buy an 8.5% stake in St. Regis. Using the proceeds from the sale, St. Regis's next move was an agreement, in June, to buy insurer Colonial Penn Group Inc. for $590 million. Like G-P, Colonial Penn became a friendly St. Regis shareholder in the preliminary transaction, with its stake amounting to 3.5%. But these maneuverings failed to shake the takeover sharks, and less than a month later, Australian publisher Rupert Murdoch purchased a 5.6% stake in the company. Then in late July, Murdoch made a $52/share offer for the rest of St. Regis, demanding that the Colonial Penn deal be called off and threatening an unfriendly and less generous tender offer if he was denied. Unintimidated, St. Regis's board rejected the Australian's offer, and by early August, St. Regis had lined up a white knight in the form of Champion International Corp. A friendly merger with Champion was completed late in 1984 through a transaction for stock and cash valued at $2.538 billion.

To help recoup the purchase price and to better integrate the two companies' operations, Champion began almost immediately to divest pieces of St. Regis. First, it sold a kraft pulp and paper mill in Tacoma, Wash., to Simpson Paper. Then in early 1986, Champion sold most of St. Regis's packaging operations to Stone Container for $457 million. Other assets divested included Hennepin Paper Co., two recycled paperboard mills and related folding carton plants in the Midwest, and the envelope division. Finally, in January 1988, Champion transferred the Canadian operations of St. Regis—including a market pulp mill at Hinton, Alta.—to a majority-owned subsidiary, Weldwood of Canada Ltd., in a deal worth $274 million.

More current events show that Champion has since been the subject of takeover speculation. More specifically, in early 1990, Loews Corp., a firm controlled by Laurence Tisch, gained approval from FTC to buy as much as 15% of Champion International's outstanding shares, and the company slightly increased that in 1991. The previous December, Champion had sold $300 million in convertible preferred stock (an 8% stake on a fully diluted basis) to Berkshire Hathaway Inc., an investment firm headed by Warren E. Buffet. Berkshire Hathaway, which is considered a friendly investor, agreed not to raise its share to more than 18% without prior board approval for a period of ten years.

Crown Zellerbach taken over. A fourth U.S. paper company to attract unwanted attention from Goldsmith was Crown Zellerbach. The British financier, operating through three affiliated companies, began his attack by purchasing an 8.6% stake in CZ in March 1985 for $78.3 million. In April, he made a $42.50/share tender offer for the company, worth $807.5 million. The company rejected that bid as too low, saying it would consider a $60/share offer from Goldsmith or any other source. CZ also announced a major restructuring to separate its timberlands and packaging operations from its other businesses. That same month, a white-knight agreement with Mead Corp. fell through, but Goldsmith withdrew his tender offer because of CZ's restructuring plan. As CZ's largest shareholder, however, Goldsmith was elected to the board of directors in May, and he spent the early summer accumulating more shares and fighting management's restructuring plan. Goldsmith's stake jumped from 19.6% at the beginning of May to 26% by early July. Goldsmith boosted his stake to 45% by mid-month and finally won control at month's end.

Over the next year, Crown Zellerbach's assets were split up into four parts. Goldsmith retained the company's timberlands and wood products businesses. James River purchased most of CZ's papermaking operations in a stock swap valued at about $1.43 billion. CZ's container division was spun off as Gaylord Container Corp. and purchased by an investor group for $260 million. Finally, CZ's paper distribution business was sold by James River to Mead for $260 million cash, making Mead, at the time, the largest integrated distributor of paper in the U.S.

Other major U.S. companies that have been the target of corporate raiders include Potlatch Corp. and Hammermill Papers. In November 1985, the Belzberg brothers of Vancouver, B.C., offered $45/share—or about $693 million—for Potlatch. That same month, however, the company bought back its shares from the Belzbergs, who agreed to forego any efforts to take over the company for five years. The $46.7-million buy-back, at $43/share, was called greenmail by some observers, but the company said it was part of a broader stock repurchase program available to all shareholders. Then in July 1986, investor Paul Bilzerian initiated a hostile takeover bid for Hammermill Papers. The company rejected the $52/share offer—worth $900 million—as inadequate, and it began discussions with other companies about a merger. Bilzerian raised his offer to $57/share, but International Paper put in a higher bid of $64.50/share—worth $1.441 billion—and won control of the company. With its 19% stake, Bilzerian's group collected some $60 million in profits pursuant to IP's tender offer. Hammermill has maintained its identity more than most takeover victims. No assets have been sold off, and IP operates it as a separate division.

Even if Goldsmith had bought B.A.T and divested certain groups—which he indicated was his intention—he would not have gained as much as he would have prior to U.S. tax law changes. The 1986 and 1987 tax reforms made it costly for raiders to sell off assets quickly. In addition, raiders have suffered adverse publicity from insider-trading scandals, and many states have passed laws limiting hostile takeovers. In spring 1990, the Supreme Court backed states' rights to undo a merger if it is anticompetitive. And Pennsylvania adopted what may be the toughest antitakeover statute in the U.S. It includes a provision to return to the target firm any profits of short-term shareholders who sell shares within 18 months of a failed buyout attempt or proxy battle. It also suspends the voting rights of holders of 20% or more of a company's stock until other shareholders reinstate them. Firms were given the option to exclude themselves within 90 days from protection under the statute. The law has since come under constitutional challenge.

RESTRUCTURING THE INDUSTRY

Corporate raiders were only one source of the dynamic shuffling of ownership that took place in the paper industry during the 1980s. A second factor was the decision of several major diversified companies to narrow their business focus and divest assets related to the cyclical paper industry. For instance, in 1980, Gulf + Western Industries sold its controlling interest in Brown to James River and Pope & Talbot, and ITT Corp. sold its two British Columbian pulp mills and related forest products operations to Western Forest Products Ltd.

The pace, if not the scale, of divestitures picked up as the recession waned in 1983 and several companies shed their paper industry assets in favor of less cyclical investments. In May 1983, Time Inc. announced the spin-off of its Inland Container Corp. and Temple-Eastex Inc. units into a new company, Temple-Inland Inc. Clevepak Corp. sold its partition mill division and other packaging assets to Rock-Tenn for about $40 million. And in 1984, Sonat Inc. sold its 50% interest in Boise Southern Co. to partner Boise Cascade for $217 million, while U.K.-based Bowater Corp. spun off its North American operations in a tax-free "demerger" that automatically created the largest U.S.-based newsprint producer, Bowater Inc. Philip Morris was another company busy reducing its presence in the paper industry. First, it sold Wisconsin Tissue Mills and Plainwell Paper Co. to Chesapeake Corp. in April 1985 for $214 million, and a month later, it exited the paper industry with the sale of Nicolet Paper Co. to Hammermill.

Owens-Illinois began its exit from the industry in early 1986, when it agreed to sell its Orange, Texas, linerboard mill and related assets to Temple-Inland for $228 million.

Next, after an LBO by Kohlberg Kravis Roberts Inc. in early 1987, O-I's Forest Products Group was sold to Great Northern Nekoosa in July. Intense bidding for these prime containerboard assets during a period of excellent market conditions helped drive up the price to $1.17 billion—near estimated replacement cost.

Also in 1986, Times Mirror sold 80% of Publishers Paper to Jefferson Smurfit for $150 million. The deal, Smurfit's first foray into the newsprint sector, included a long-term supply contract for newsprint for Times Mirror publications. Smurfit was also involved in another big divestiture of 1986: Mobil Corp.'s sale of Container Corp. of America for $1.16 billion to a partnership between Smurfit and a Morgan Stanley investor group. Mobil had owned CCA since 1976.

In November 1989, Jefferson Smurfit Group of Ireland and the Morgan Stanley Leveraged Equity Fund II (the investment affiliate of Morgan Stanley) completed a deal in which a joint-venture holding company, SIBV/MS Holdings Inc., acquired complete ownership of JSC, which in turn had taken 100% ownership of CCA.

Repositioning businesses. Companies inside the industry also moved to streamline operations and rethink business strategies. In a major restructuring aimed at reducing the cyclicality of its earnings stream, Mead ended joint ventures with Temple-Inland and Scott Paper in 1987 and 1988 and sold its recycled paperboard business to Rock-Tenn. In the dissolution of the joint ventures, the Georgia Kraft Co. linerboard mill at Macon, Ga., was sold to Pratt Holdings Pty Ltd. of Australia, and Brunswick Pulp & Paper was sold to Georgia-Pacific (the Brunswick mill more than doubled G-P's bleached board capacity and doubled the company's export capacity for market pulp).

In a move to concentrate on printing/writing papers, Pentair Inc. sold its Port Huron, Mich., specialty papers mill to E.B. Eddy Forest Products Ltd. of Canada in August 1987. Pentair's other specialty papers mill in Detroit, Mich., was sold in December to Kapaco Group, which in turn sold the mill to Ivex Corp. in 1991.

Louisiana-Pacific Corp. took steps in 1987 to distance itself from asbestos liability and to leave the containerboard sector with the spin-off of Fibreboard Corp. The move concentrated L-P's assets in market pulp and forest products. Fibreboard's containerboard division was sold to Gaylord Container for $156 million.

Restructuring activity increased as the economy slowed in the 1990s, with major restructuring/divestment programs, as noted previously, being implemented by the likes of James River and Scott Paper.

Foreign interests. The Japanese have been growing players in the North American industry. Many Japanese investments have been north of the border in Canada, but there have been a few purchases in the U.S. as well, starting in 1987 with Daishowa America Co. Ltd.'s purchase of an uncoated groundwood paper mill at Port Angeles, Wash., from James River for $75 million. In the same year, Settsu Corp. of Japan forged a presence in the U.S. market through the purchase of a 21.5% interest in privately held Caraustar Industries Inc., the fourth largest U.S. producer of recycled paperboard.

Australians were also active in 1987. Smorgon Consolidated Industries Pty Ltd., a Melbourne-based recycled containerboard producer, entered the U.S. market in May with the purchase of FSC Paper Corp. Three months later, a little-known Australian company, Pratt Holdings, acquired the Macon mill of Georgia Kraft. Subsequently, there have been rumors that Pratt might be interested in selling off its U.S. operations, which now also include a recycled medium mill in Hartford City, Ind. In September 1991, Pratt announced a possible joint effort with Riverwood International to manufacture coated kraft board at the Macon mill.

Overseas investment by U.S. companies, meanwhile, has picked up in pace in recent years abroad. In particular, U.S. firms have participated in a wave of M&A activity that has beset Europe as producers jockey for position before the creation of the new European market in 1992. According to Shearson Lehman Brothers, more than 23 European deals were consummated by U.S. firms from 1988 through first-quarter 1991. Among the most aggressive purchasers in Europe have been International Paper, Federal Paper Board, James River (discussed earlier), and Stone Container.

International Paper's foray into Europe, especially the white papers end of the business, has been documented earlier in this chapter and includes the acquisition of Aussedat Rey and a majority position in Zanders Feinpapiere. Federal Paper Board acquired Scottish white paper producer Thomas Tait & Sons Ltd. early in 1989. Besides giving Federal a manufacturing presence in the Common Market, the acquisition reduced Federal's exposure to market pulp since Tait is a nonintegrated producer. After acquiring German containerboard (Europa Carton) operations and a British newsprint mill from its 1989 purchase of Consolidated-Bathurst, Stone Container acquired box operations in Germany (Wellpapenwerk Waren) and a 30% interest in Belgian firm, Cartonmills, in late 1990.

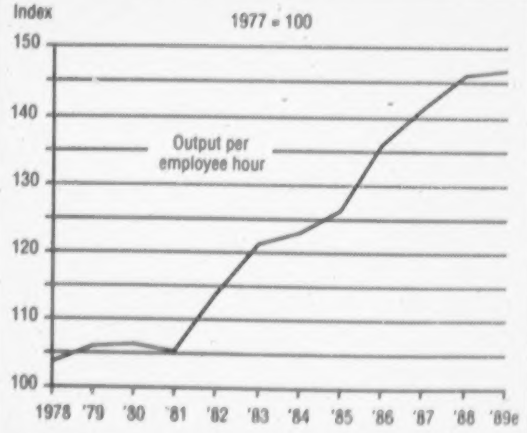
Other U.S. companies active in Europe include Sonoco Products Co., which acquired a controlling interest in Lhomme SA, a leading French manufacturer of paperboard tubes, and Procter & Gamble, which undertook the formation of joint ventures on the continent to establish itself in Europe's consumer products markets. Riverwood International Corp., formerly known as Manville Forest Products, in the meantime acquired several converting operations in Spain, the U.K., and Sweden (Manville has also invested in Australia, where, in August 1990, it acquired five folding carton plants from the Pratt Group's Visypack carton unit).

United States:

LABOR

As in many American manufacturing segments, it is generally recognized that U.S. paper industry unions have been losing power and membership over the past several years as companies insist on cost-cutting measures to remain competitive. Mills have been able to demand contract concessions, such as modest wage increases, health coverage reductions, and the elimination of premium pay. But in 1991, the paper industry's largest labor organization, the United Paperworkers International Union (UPIU AFL-CIO), appeared to be making headway with strategies to retain labor's influence in corporate policy, including the formation of cooperative management committees and a controversial pooled voting strategy to unite locals at separate locations of a given company. The union was active on a national level, heavily promoting federal legislation that would ban the permanent replacement of striking workers and taking initiative on the issue of national health care. UPIU also said it would try to increase its role in mergers and acquisitions that affect its members.

PRODUCTIVITY OF PRODUCTION WORKERS AT PULP, PAPER, AND BOARD MILLS



Source: Bureau of Labor Statistics, American Paper Institute.

U.S. PAPER AND ALLIED PRODUCTS EMPLOYMENT AND EARNINGS, 1965-89

Year	All employees (000)	Production workers (000)	Average hourly earnings	Average weekly earnings
1989e	697.2	525.4	$11.93	$516
1988	692.6	523.8	11.65	503
1987	680.1	516.3	11.43	496
1986	673.7	511.0	11.16	483
1985	677.7	512.1	10.83	467
1984	680.9	511.6	10.41	449
1983	661.2	494.5	9.93	423
1982	662.4	493.9	9.32	390
1981	688.5	518.4	8.60	366
1980	692.8	522.7	7.84	331
1979	706.8	535.6	7.13	304
1978	698.7	524.7	6.52	280
1977	691.6	518.2	5.96	256
1976	675.5	508.3	5.47	232
1975	642.0	479.7	5.01	208
1974	706.1	544.3	4.53	191
1973	704.6	543.1	4.20	180
1972	688.9	531.6	3.95	169
1971	681.9	521.8	3.67	155
1970	705.5	543.2	3.44	144
1965	639.1	497.7	2.65	114

e = Estimate.
Source: Bureau of Labor Statistics.

Pulp, paper, and paperboard operations were forecast to employ a total of 198,900 U.S. workers in 1991, a number that has remained steady since 1989, according to the U.S. Dept. of Commerce's 1991 U.S. "Industrial Outlook." Pulp, paper, and paperboard production workers numbered about 153,000 in 1991, while the more labor-intensive converting group of industries employed a work force of more than 400,000, government statistics show. The steady rate of employment, along with a flat trend of paper and paperboard production since 1988, has caused productivity level gains for paper and allied product workers to decline from a 7.5% increase in output per employee in 1986 to 0.4% in 1989. The American Paper Institute projects a 1.7% gain in output per employee hour in 1990 from 1989 but a smaller increase for 1991. These gains are well below the longer-term productivity increases of 3.7% annually from 1947 to 1989. The January 1991 index of output per manhour trends was 3.0% above its 1988 level, API reported.

Most organized American paper industry workers are represented by Nashville, Tenn.-based UPIU. It is the largest North American paperworkers' union, representing over 228,000 employees across the U.S. and about 1,700 workers in central Canada. Both figures are slightly down from 1990 figures. One-third of the union's membership is primary pulp and paper workers, and two-thirds are employees in the paper converting industry. UPIU is headed by Wayne E. Glenn, 68, who has served as president since 1978. The Assn. of Western Pulp & Paper Workers (AWPPW), based in Portland, Ore., represents approximately 15,500 primary workers in the Pacific Northwest, California, and Alaska. The independent union is headed by president Farris Bryson, who was elected in 1976. UPIU was formed in 1972 by the merger of the United Papermakers & Paperworkers and the International Brotherhood of Pulp, Sulphite, & Paper Mill Workers. AWPPW had broken from the Pulp, Sulphite, & Paper Mill workers in 1964. Glenn's term of office at UPIU ends in 1992, but he is eligible to serve until 1996. AWPPW held its convention to elect officers in October 1991.

Another union with a large presence in the paper industry is the International Brotherhood of Electrical Workers (IBEW). Of the union's total U.S. membership of 820,000, about 7,000 workers are employed in the paper industry, mainly as part of small electrical maintenance locals. Capital spending projects in the paper industry, be it greenfield construction or machine rebuilds, provide jobs to thousands more workers in construction, machinist, carpenters, plumbers, and engineering unions. In that regard, capital spending curtailments and the use of nonunion contractors by the paper industry is of concern to various labor organizations.

HOURLY EARNINGS OF U.S. PAPER AND ALLIED INDUSTRY PRODUCTION WORKERS, 1983-89

	1989	1988	1987	1986	1985	1984	1983
Paper and allied products	$11.93	$11.65	$11.43	$11.18	$10.83	$10.41	$9.93
Paper and pulp mills[1]	14.71	14.31	14.01	13.63	13.14	12.43	11.70
Paperboard mills	14.76	14.49	14.30	13.98	13.60	12.99	12.11
Misc. converted paper products	10.39	10.10	9.90	9.62	9.33	9.09	8.71
Paperboard containers/boxes	10.16	9.99	9.77	9.58	9.24	8.92	8.60
All U.S. manufacturing	n.a.	10.37	10.07	9.73	9.53	9.19	8.83
Paperboard containers/boxes	210.6	206.8	201.8	196.9	196.9	197.2	190.6

n.a. = Not available.
1. Includes construction paper/board mills.
Sources: Bureau of Labor Statistics, American Paper Institute.

TOTAL U.S. PAPER AND ALLIED PRODUCTS INDUSTRY EMPLOYMENT BY SEGMENTS, 1983-89

(000 employees)

	1989	1988	1987	1986	1985	1984	1983
Paper and allied products	697.2	692.6	680.1	673.7	677.7	680.9	661.2
Paper and pulp mills[1]	194.3	194.4	191.8	194.5	197.0	200.0	198.0
Paperboard mills	52.9	52.9	53.6	53.6	55.3	57.2	58.2
Misc. converted paper products	239.5	238.6	232.8	229.0	228.5	226.5	214.4
Paperboard containers/boxes	210.6	206.8	201.8	196.9	196.9	197.2	190.6

1. Includes construction paper/board mills.
Source: Bureau of Labor Statistics.

STRIKES AND WAGE HIKES DECREASE

Three brief strikes occurred in the U.S. paper industry over the first nine months of 1991, with five in 1990 and only one in 1989. This compares with 19 strikes in 1983 and 16 in 1986. UPIU Local 375, with 130 members, struck at Packaging Corp. of America's Bristol, Pa., container plant Aug. 1-4 over the company's attempt to establish an 80:20 health insurance plan. About 100 UPIU Local 3 members at Merrimac Paper Co. Inc. in Lawrence, Mass., received a 5% wage hike after a three-week strike ended July 21. In May, 190 members of UPIU Local 1419 struck Interstate Container Corp. in Reading, Pa., for two weeks over vacation issues before settling for a three-year pact. Two major strikes in

1990 were by AWPPW members at Georgia-Pacific Corp.'s Toledo, Ore., mill and at ITT Rayonier Inc.'s pulp mill in Hoquiam, Wash. In May 1990, Jefferson Smurfit Corp. locked out UPIU workers at plants in Ohio, and other disruptions were reported by UPIU workers at U.S. carton plants.

Over the past few years, companies have generally been able to eliminate Sunday premium pay and redesign work practices and job descriptions. More recent developments in labor negotiations include the declining use of lump-sum payments in substitution of a first-year wage increase and a dramatic increase in four- and five-year contracts. Through July 1991, about half of the 25 agreements reached were for more than three years. But the number of agreements reached was only half of that during the same period in 1990, indicating some drawn-out negotiations. Wage hikes also dipped during first-half 1991, averaging 2.2% through August compared with 2.5% for the entire year of 1990.

Contracts for paperworkers generally set the agenda for other tradesmen. IBEW reported general wage increases of 2% to 2.5% annually in three- and four-year agreements at paper mills in 1990. Most included signing bonuses of $1,500, while wage increases with no bonus ran as high as 5% in some of the 88 collective bargaining agreements the union signed in 1990-91. Among important contract issues for trade workers is multicraft, or cross-crafting, in which the company seeks to train employees in varied skills, such as training an electrician to be a pipe fitter. Monetary incentives to learn other skills have somewhat calmed union concerns about job security, but the issue causes inevitable concern whenever it is introduced at a mill.

HEALTH CARE, A VITAL ISSUE

Among the most pressing contract issue in current negotiations is health insurance. Current estimates provided by AFL-CIO show that, at current rates, health care coverage will account for 100% of the U.S. GNP by the year 2042. As of mid-1991, 11.8% of the entire U.S. GNP went toward health care, and a study by AFL-CIO showed that 55% of all U.S. strikes in 1990 were over health care issues. Currently, it costs the average American company $3,000/employee for health benefits, and by the year 2005, costs will reach $22,000/worker. To tackle this and other issues, UPIU found an inventive way of establishing cooperation with employers through high-level, joint labor-management committees with James River Corp. and with Scott Paper Co. One fruit of the union's effort was the formation in May 1991 of a "Health Care Reform Partnership," a first in the paper industry, to push for fundamental health care reforms. The partnership promised to break new ground in the effort to contain skyrocketing health insurance costs, especially as these costs increasingly become a factor in international cost-competitiveness.

Industry analysts said that keeping a lid on escalating health insurance costs will be on the main agenda of most paper companies in labor bargaining rounds through the

AVERAGE FIRST-YEAR WAGE INCREASES IN U.S. PULP AND PAPER INDUSTRY, 1979-91

Year	New England	East	Midwest	South	Pacific	Total U.S.
1991*	2.9%	1.6%	2.3%	2.7%	0.4%	2.2%
1990	1.3	2.5	2.4	2.9	2.8	2.5
1989	1.2	2.8	0.5	1.0	0.0	1.1
1988	0.4	1.9	1.1	0.2	0.5	0.9
1987	0.3	1.3	0.6	0.1	0.0	0.4
1986	1.0	0.6	0.5	0.1	0.2	0.3
1985	2.3	3.4	3.2	1.6	-1.1	2.1
1984	4.9	4.3	4.6	5.3	-0.9	3.3
1983	5.8	5.2	5.1	5.9	1.3	5.6
1982	7.3	6.7	6.6	6.8	7.7	6.9
1981	8.8	9.0	8.5	8.2	9.0	8.7
1980	10.7	9.8	9.3	8.7	9.8	9.2
1979	9.6	9.4	9.5	10.0	10.0	9.6

*Through August.
Source: American Paper Institute.

U.S. PAPER INDUSTRY UNIONS

Union	Region represented	Members	
		Total	Primary pulp and paper
United Paperworkers International Union	U.S.	228,000*	85,000
Assn. of Western Pulp & Paper Workers	Pacific Northwest	15,500	15,500
International Brotherhood of Electrical Workers	U.S.	7,000	—

*Includes approximately 40,000 employed in areas such as chemicals and hospitals. Firemen and Oilers, United Steelworkers of America, Teamsters, Graphic Communications International Union, International Assn. of Machinists & Aerospace Workers, and other major unions also have representation in paper industry.

coming years. Health care costs are currently estimated to consume almost 45% of business operating profits, with the health care rate of inflation almost double the Consumer Price Index in 1990. The issue is receiving widespread publicity, with pieces of limited legislation moving through the U.S. Congress and with the American Medical Assn. calling for a national health care policy. Among reforms the new JR-UPIU agreement calls for are a specific expenditure budget for all necessary health services, limiting overall expenses to an inflation rate no greater than the CPI, and tax incentives and penalties to encourage all employers to participate in a national health care system.

In mid-1991, UPIU added an old nemesis to its labor management effort when it buried the hatchet with Champion International Corp., ending a legal dispute regarding a pool of 6,000 workers at seven mills that began in 1989. A joint statement of principles called on the two entities to work together to improve the company's performance and also set forth Champion's acceptance of "the legitimacy and institutional integrity" of the union. But the pool strategy remained very much alive in the minds of union leadership, particularly in regard to its effort against International Paper Co. UPIU began pooling locals at IP locations across the U.S. in early 1990 and by mid-1991 had signed up over 40 locals at 25 company locations, involving 8,000 workers. IP filed unfair labor practice charges against the union through the National Labor Relations Board and sought a temporary restraining order against the pool until NLRB ruled on the case. A federal judge in May failed to issue an injunction against the union's effort, and further hearings were planned.

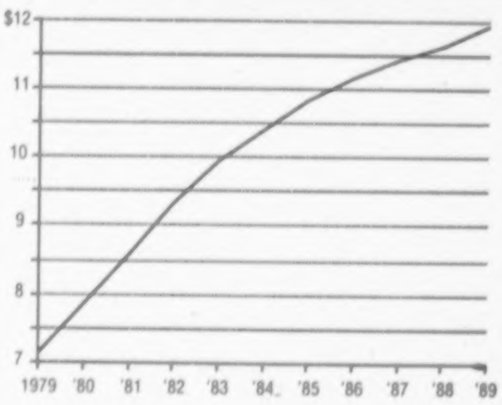
PRODUCTIVITY INDEXES FOR U.S. PAPER AND ALLIED PRODUCTS

(output per employee hours; 1977 = 100)

Year	Production workers	All employees
Pulp, paper, and board mills		
1989e	146.7	143.5
1988	146.0	142.8
1987	141.3	138.0
1986	135.8	133.5
1985	126.3	123.1
1984	123.1	121.0
Average annual percent change		
1984-89	3.5%	3.5%
1983	121.3	119.5
1982	113.7	111.3
1981	105.5	104.4
1980	106.4	105.2
1979	106.2	105.4
1978	103.7	103.2
1977	100.0	100.0
1976	95.0	95.0
1975	87.7	86.7
1974	90.5	91.5
1973	90.2	91.5
1970	75.8	77.5
1960	48.8	50.6
1954	37.9	40.4
Average annual percent change		
1947-85	4.1%	3.7%
Corrugated and solid fiber boxes		
Average annual percent change		
1958-85	4.0%	3.7%
1973-85	2.6%	2.5%
Folding paperboard boxes		
Average annual percent change		
1963-85	1.9%	1.8%
1973-85	0.6%	0.6%

e = Estimate.
Source: Bureau of Labor Statistics, American Paper Institute.

AVERAGE HOURLY EARNINGS OF PRODUCTION WORKERS



Source: Bureau of Labor Statistics, American Paper Institute.

United States:

TIMBER RESOURCES AND PULPWOOD COSTS

Forests cover about one-third of the U.S. Two-thirds of that forest, or nearly 200 million hectares (ha), is timberland that, according to the U.S. Forest Service definition, yields at least 1.4 m^3/ha of wood annually. Approximately 5% of the forest is reserved for parks and wilderness. The remaining forest, which yields less than 1.4 m^3/ha, is termed woodland.

Roughly one-fourth of both the hardwood and softwood harvest is used for pulpwood. Hardwood's share of total U.S. growing stock rose from 29% in 1952 to about 40% currently and is expected to make further gains as softwood supplies tighten up. Western timberland is predominantly forested by softwood, while hardwood makes up about 80% of northern and 65% of southern timberland.

In terms of ownership, according to Dean Witter, in 1988 more than 90% of the southern timber harvest came from private land, while only 50% of the timber harvest in Oregon and Washington came from private land.

Harvest restrictions. Since 1988, access to government timber, especially in the Pacific Northwest, has been limited. The U.S. Forest Service presented just 2.4 billion bd ft for sale from Region 6 (Oregon and Washington) during the federal fiscal year that begins Oct. 1. An additional 2.4 billion bd ft were tied up that summer by court injunctions to protect the northern spotted owl and old-growth timber. To compensate for the slow pace in 1989, Congress passed legislation that year to allow sales of 5.3 billion bd ft in fiscal 1990. As a result, 7.3 billion bd ft were sold during that two-year period.

Reductions in public timber sales will continue on a national scale. President Bush signed a Dept. of Interior appropriations bill authorizing the reduction of forest timber sales from 10.7 billion bd ft nationwide in fiscal 1990 to 9.6 billion bd ft for fiscal 1991. The bill set sales of 3.2 billion bd ft for the Northwest, compared with a total of 7.7 billion bd ft for the previous two years combined.

U.S. Forest Service timber sales were not expected to reach the limit imposed for 1991, however, as the board feet allotted did not reflect possible adjustments to protect the northern spotted owl, declared a threatened species in June 1990. In fact, Forest Service timber sales during first-half fiscal 1991 reached just 15% of 1990's year-to-date sales in Region 6, according to analyst Evadna Lynn of Dean Witter.

In Feb. 1991, as a result of a lawsuit initiated by the Sierra Legal Defense Fund, a U.S. District Court in Washington ordered the U.S. Fish and Wildlife Service (FWS) to designate critical habitats for the northern spotted owl.

U.S. DEMAND FOR TIMBER PRODUCTS, 1986-2040

Product	Standard unit of measure	Consumption 1986	Projected demands—medium level 2000	2040
Lumber	Billion bd ft	56.8	55.2	69.4
Plywood	Billion ft^2, 3/8-in. basis	23.5	20.7	27.3
Board*	Billion ft^2, 3/8-in. basis	20.1	27.9	38.1
Pulpwood (U.S. mills)	Million cords	92.1	112.3	158.2
Other industrial products	Billion ft^3	0.5	0.8	1.4
Fuelwood (roundwood)	Billion ft^3	3.3	4.3	5.1
Total roundwood, sawtimber	Billion ft^3	20.5	22.9	28.6

*Includes particleboard, insulating board, hardboard, oriented strand board/waferboard.

Source: U.S. Forest Service, "An Analysis of the Timber Situation in the U.S., 1950-2040," 1990.

FWS subsequently proposed 190 spotted owl Critical Habitat Areas, covering 11.6 million acres in California, Oregon, and Washington. As three million of the prescribed acres are on private land, the extent to which logging can be restricted remains unclear. For the time being, the Sierra Club Legal Defense Fund has asked a federal judge to prohibit FWS from clearing for harvest timber sales on these sites. If implemented, such a moratorium would affect new sales and those sales cleared for harvest after the critical habitat sites were proposed.

U.S. PULPWOOD RECEIPTS

(000 standard cords, roundwood basis)

Year	Total receipts	Softwoods	Hardwoods
1989	97,016	67,096	29,920
1988	95,063	65,806	29,257
1987	93,890	65,295	28,595
1986	90,623	63,305	27,319
1985	85,349	60,207	25,142
1984	88,035	62,858	25,177
1983	82,390	58,959	23,431
1982	73,541	56,387	20,887
1981	79,336	58,818	20,517
1980	81,007	60,170	20,837
1979	76,928	57,439	19,489
1978	74,824	55,567	19,257
1977	72,867	55,389	17,479
1976	72,265	54,433	17,831
1975	65,456	49,280	16,175
1974	77,103	56,189	20,194

Source: Bureau of the Census, "Current Industrial Reports Series MA26A."

U.S. PULPWOOD RECEIPTS BY REGION

(000 cords, roundwood and residues)

Year	Total	Northeast	North Central	South Atlantic	South Central	West
1990	99,304	7,264	7,074	32,536	37,246	15,184
1989	99,279	7,242	7,020	31,982	35,840	17,196
1988	95,547	7,187	6,865	31,582	33,761	16,152
1987	93,835	6,962	6,555	30,492	33,644	16,182
1986	89,396	7,277	6,574	28,875	31,054	15,616
1985	84,878	7,430	6,429	27,398	29,362	14,259
1984	88,713	7,879	6,873	27,570	30,893	15,498
1983	82,466	7,087	5,945	25,532	28,915	14,987
1982	78,319	7,095	5,585	24,467	26,348	14,835
1981	81,108	7,459	5,639	25,356	27,744	14,910
1980	81,008	7,159	5,970	25,511	25,872	16,497
1979	78,625	7,461	5,630	26,126	26,654	12,754
1978	76,138	6,179	5,302	25,353	25,572	13,732
1977	73,774	5,887	5,464	22,834	24,652	14,937

Source: American Pulpwood Assn.

In May 1991, Federal District Court Judge William Dwyer in Seattle, Wash., halted U.S. Forest Service timber sales on 66,000 acres of spotted owl habitat in Washington, Oregon, and California. The ruling gave the Forest Service until March 1992 to file an environmental impact statement and spotted owl preservation plan, after which timber sales may possibly resume.

Bureau of Land Management (BLM) timber auctions have also been affected by the spotted owl controversy. In mid-1990, a plan announced for BLM timberlands in the Northwest reduced the harvest from 950 million to 750 million bd ft annually. A year later, however, an additional 260 million bd ft were withdrawn from sale after the FWS ruled the sales would jeopardize the spotted owl.

Wood products revive. The wood products market sagged in 1990 but showed hints of a recovery the following spring, as housing starts appeared to pick up after an anemic year. Housing starts dropped 13% to 1.19 million in 1990. Analysts expected starts to reach 1.1 to 1.2 million units in 1991 and 1.3 to 1.4 million in 1992.

Much excess capacity has been squeezed out of business in response to the economic climate. As a result, a wood products shortage could develop within a few years if both the new housing and repair/remodel markets revive. Months of high stumpage costs, low lumber and plywood prices, and slim orders have taken their toll on the wood products industry nationwide. In addition, preservation of old-growth forests, protection of the northern spotted owl, and exports of raw logs to lucrative overseas markets such as Japan have triggered the closing of some Pacific Northwest sawmills. In 1990, Congress banned timber exports from public land in an attempt to ensure the supply of enough regional raw wood to help keep the remaining local sawmills in business. Nevertheless, Oregon-based consultant Paul Ehinger, who tracks mill closures, noted that 53 sawmills and panel plants in Oregon, Washington, and Idaho shut down in 1990, more than twice the closures seen in the 1982 recession.

The forces affecting the Pacific Northwest will lead domestic and export log prices to increase sharply in the coming months and years, according to Oppenheimer & Co. Inc. analyst Gary Palmero. Southern prices may rise due to the same pressure. According to Lynn of Dean Witter, shrinking southern timber supplies can be attributed to environmental pressures, the fact that much mature timber has been cut, and the completion of the harvest of salvageable timber felled by Hurricane Hugo, which damaged nearly one-third of South Carolina's forestland in September 1989.

Pulpwood repercussions. Outages and closures at sawmills diminished the supply of residual chips used to make pulp. The shortage compounded periodic scares about restrictions on federal timber sales, leading nervous pulp producers to stockpile chips. Chip inventories for principal firms in the Northwest ballooned to 2 million bdu by the end of 1989 and remained fairly strong throughout 1990, helping to maintain moderately stable chip prices. By March 1991, however, inventories receded to 900,000 bdu, though they subsequently appeared to recover.

Once the economy revives and companies in the Pacific Northwest contend with low federal timber sales, spotted owl protection measures, overseas demand, and the full impact of numerous sawmill closures, chip consumers could face a real supply squeeze.

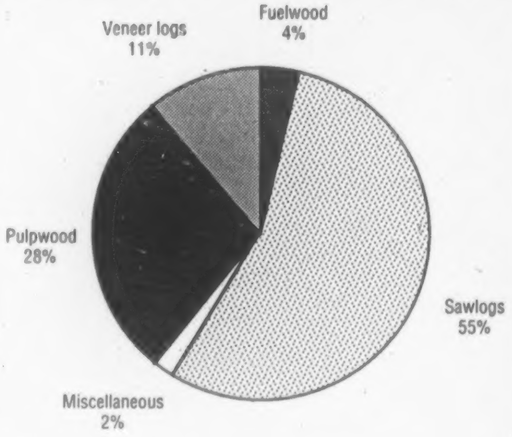
Boise Cascade exemplifies the industry's response to these market forces. The firm is turning to increased recycling, as well as self-sufficiency, by purchasing a whole-log chipping facility in Oregon. Boise also plans to develop a hardwood forest plantation in Washington near its Wallula pulp and paper mill. And the company intends to minimize the impact of rising Pacific Northwest woodchip prices by extricating itself from that region and expanding elsewhere in North America. Not all plants will be able to relocate, and in the meantime, chip users are suffering. Gaylord Container Corp. announced early in 1991 that it would temporarily idle two containerboard machines and the kraft pulp production at its Antioch, Calif., mill, due in part to rising West Coast wood costs.

Increased costs can be attributed to some extent to competition between domestic and overseas consumers, which could push prices beyond the reach of domestic mills when the economy revives. According to the American Pulpwood Assn., Japanese demand alone has reached nearly 3 million bdu of chips from the western states, vs approximately 13 million bone-dry tons of chips used in Washington and Oregon. The U.S. could ban chip exports, but in a more likely scenario, Japanese customers will ultimately turn to markets outside the Pacific Northwest.

Of course, customers in the Pacific Northwest could utilize alternative sources or species. Chips could be shipped in from the southern U.S. or from Central and South America. Some in the industry indicate that prohibitive freight expenses would make this alternative untenable. But as of mid-1991, James River Corp. said its northwestern mills were paying twice as much for woodchips as its southeastern mills.

Price trends. Prices for chips exported from the Pacific

SOFTWOOD TIMBER CONSUMPTION IN THE U.S.



Source: American Forest Council.

U.S. PULPWOOD CONSUMPTION

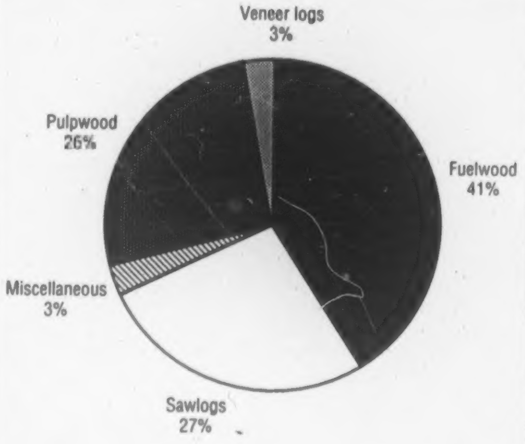
(000 cords)

Year	Total consumption	Northeast	North Central	South Atlantic	South Central	West
1990	99,109	7,080	7,129	32,412	36,784	15,704
1989	98,414	7,072	6,963	32,239	35,791	16,349
1988	95,497	7,216	6,929	31,567	33,646	16,139
1987	93,946	7,109	6,764	30,915	33,059	16,099
1986	91,434	7,226	6,730	29,425	32,113	15,939
1985	85,557	7,358	6,304	27,763	29,887	14,245
1984	87,621	7,474	6,563	27,292	30,529	15,763
1983	85,442	7,274	6,343	25,847	29,152	16,826
1982	76,257	6,695	5,419	24,054	26,652	13,417
1981	81,178	7,025	5,762	25,494	27,627	15,270
1980	79,703	7,318	5,714	24,960	26,246	15,465
1979	77,362	6,749	5,729	24,427	25,419	15,038
1978	74,170	6,501	5,492	23,701	25,119	13,357
1977	73,970	5,949	5,473	22,817	24,468	15,063
1976	73,209	5,777	5,442	22,673	24,969	14,247
1975	65,421	5,417	4,779	19,983	22,042	13,200
1974	74,459	6,149	5,678	22,926	24,240	15,466

Source: American Pulpwood Assn.

Northwest to Japan held steady throughout first-half 1991, with Douglas fir chips going for $122/bdu f.o.b. vessel, red alder for $121, and B.C. spruce/pine/fir fetching $123.60. Those prices were considerably higher than in second-half 1990, when Douglas fir chips sold for $109.40, red alder for $113, and spruce/pine/fir chips stood at $111.

HARDWOOD TIMBER CONSUMPTION IN THE U.S.



Source: American Forest Council.

In the domestic market, Douglas fir chips in the Eugene-Springfield, Ore., region reached $95 to $110/bdu delivered in June 1991, nearly level with $92 to $110 in March, and up from $81 to $95 in December 1990, according to *Wood Fibre Northwest*. In the Longview, Wash., area, those chips went for $110 to $125 in June 1991, level with March figures but up from $86 to $107 in December 1990.

Southern roundwood and chip prices appear to be somewhat soft, with supplies adequate for demand. Slow pulp, paper, and board markets kept chip demand depressed in first-half 1991. Simultaneously, a reviving housing market added to chip supplies, leading to speculation that oversupply might ensue.

As in the Pacific Northwest, stagnant southern chip prices caused some difficulties because stumpage was still relatively high and lumber was down. In first-half 1991, stumpage rates were fairly consistent with 1990 prices. The impact of sawmill downtime on chip supply, however, intensified demand for pulpwood and helped support the price of pine pulpwood stumpage. Southern stumpage may continue to rise if housing starts approach 1989 levels and West Coast timber becomes scarce.

In the chip market, tabs were expected to hold steady throughout 1991, unless oversupply occurred and prices deflated slightly. Quotes from industry contacts for southeastern green pine chips in first-half 1991 ranged from the low

PULPWOOD CONSUMPTION, EXPORTS, IMPORTS, AND PRODUCTION IN THE U.S., SPECIFIED YEARS 1952-86, WITH PROJECTIONS TO 2040

(million cords)

Year	Consumption	Exports	Imports	Production				
				Total production	Roundwood			Chips
					Total	Softwoods	Hardwoods	
1986	92.1	1.9	0.6	93.4	57.1	35.3	21.8	36.3
1976	75.3	3.3	1.1	77.4	47.6	33.0	14.7	29.8
1970	69.6	2.0	1.1	70.5	50.2	36.7	13.6	20.2
1962	44.1	0.1	1.4	42.8	33.3	24.3	9.0	9.4
1952	27.2	—*	2.1	25.0	23.5	20.0	3.5	1.6

PROJECTIONS

Year	Demand in U.S. mills	Exports	Imports	Demand				
				Total demand	Roundwood			Chips
					Total	Softwoods	Hardwoods	
2000	112.3	1.9	1.3	112.9	84.7	49.4	35.3	28.2
2010	130.0	1.7	1.2	130.5	101.8	56.4	45.4	28.7
2020	141.9	1.6	1.1	142.4	110.2	60.2	50.0	32.2
2030	152.1	1.5	1.0	152.6	118.6	63.9	54.7	34.0
2040	158.2	1.5	1.0	158.7	124.1	66.6	57.5	34.6

*Less than 50,000 cords.
Note: Data may not add to totals because of rounding.
Source: U.S. Dept. of Agriculture, Forest Service.

to high $20s/ton f.o.b. mill, up just slightly from 1990 averages. Southeastern hardwood, which had been selling for $15 to $20/ton when the export market was stronger, reportedly fell to $14 to $18/ton. In the South, chip prices rose slightly after the first of the year, bringing pine on average to the low to mid $20s/ton of green chips in first-half 1991. Hardwood chips in the South held at about $19 to $20. Tabs for pulpwood and chips in the South and on the East Coast were also stable throughout second-half 1990.

According to *Timber Mart-South*, pine roundwood in 13 southern states held at approximately $48/cord f.o.b. yard through the first three quarters of 1990, dropped to about $47/cord for the next two quarters, and rebounded to about $50/cord in second-quarter 1991. Hardwood roundwood stayed near $41 in 1990, with the exception of the second quarter, when it temporarily increased to nearly $43/cord. First-half 1991 sales were around $40/cord. In the chip arena, *Timber Mart-South* indicated pine slipped from about $22/ton of green chips f.o.b. sawmill in first-quarter 1990 to $21 by year end, then edged up to $22 the next quarter only to drop again in second-quarter 1991. Hardwood chips followed the same trend over that 18-month period, vacillating between $16 to $17/ton.

Japanese imports from the southern U.S. remain steady and continue to be comprised mostly of hardwood. Europe used to import pine chips from the East Coast but closed shipments down because of nematode problems. Now that market could be nearing a rebirth with the increasing "real interest in fumigating shiploads of chips," according to one industry observer.

U.S. TIMBER HOLDINGS OWNED OR CONTROLLED BY MAJOR U.S. PAPER COMPANIES

Company	Acreage (000 acres)
Weyerhaeuser	19,112
Georgia-Pacific	9,250*
Champion International	6,397
IP Timberlands	6,300
Boise Cascade	6,185*
Scott Paper	2,800*
Union Camp	1,664
James River	1,600
Louisiana-Pacific	1,531

*U.S. and Canada total.
Source: 1990 annual reports.

Wetlands wild card. Southern producers are keeping a watchful eye on the wetlands issue, which has yet to impact the industry but could prove explosive. Two hundred years ago, the current boundaries of the continental U.S. enclosed about 221 million acres of wetlands, but since then just over half of the wetlands have been lost, according to FWS.

Contributing to the decline is the fact that at present, some forestry operations are not generally required to have a permit to operate, even on wetlands. There is some speculation, however, that the Army Corps of Engineers or the Environmental Protection Agency may implement a permit system. In addition, the industry faces the consequences of the 1989 federal revision of the definition of wetlands, which is far more comprehensive than its predecessor. (The manual in which it is published was developed to enforce wetlands regulations included in Section 404 of the Clean Water Act, soon up for reauthorization.) In some coastal counties, the old definition—which encompasses swamps, marshes, and bogs—covered perhaps 25% of the land, whereas the new definition classifies almost 90% of the land as wetlands. Government agencies are considering a revision of the new definition, however, that will encompass fewer acres.

TIMBER SALES FROM WESTERN WASHINGTON AND WESTERN OREGON

	Timber sold on publicly owned lands		National forest only	
Year	(billion bd ft)	($/000 bd ft)	Douglas fir ($/000 bd ft)	All species* ($/000 bd ft)
1990	5.3	$319	$407	$264
1989	2.8	300	390	268
1988	5.0	200	256	206
1987	5.4	150	190	162
1986	6.2	108	161	128
1985	4.8	86	126	101
1984	5.0	90	133	95
1983	5.2	115	162	113
1982	5.6	93	118	80
1981	5.2	228	350	231
1980	5.7	291	432	432
Average	5.1	$180	$248	$189

*Covers Washington, Oregon, and northern California.
Source: U.S. Forest Service.

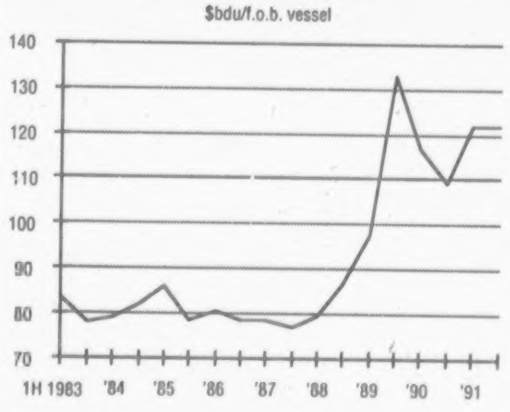
The East Coast has also run into its share of environmental restrictions. In Maine, New Hampshire, New York, and Vermont, 26 million acres of forestland are involved in a dispute between environmentalists, developers, and the wood products industry. The National Forest Products Assn. noted that most of the northern forests are privately held and are being developed for housing. This has angered environmentalists, who want to purchase the land to ensure forest preservation.

U.S. EXPORTS AND VALUE OF WOODCHIPS

Year	Quantity Short tons	Quantity Metric tons	Value	Average value $/short ton	Average value $/metric ton
1990	4,637,669	4,208,411	412,018,000	$88.84	$97.90
1989	4,357,811	3,954,456	388,154,000	89.07	98.16
1988	3,503,100	3,178,857	286,191,000	81.70	90.03
1987	2,546,467	2,310,769	188,459,018	74.01	81.58
1986	2,428,333	2,202,935	170,022,023	70.02	77.18
1985	2,317,989	2,102,833	168,813,781	72.83	80.28
1984	2,325,163	2,109,341	164,058,053	70.56	77.78
1983	2,554,176	2,317,097	171,269,000	67.05	73.92
1982	2,860,133	2,594,655	231,140,000	80.81	89.08
1981	3,846,049	3,489,059	314,037,000	81.65	90.00
1980	4,478,234	4,062,564	377,899,701	84.39	93.02
1979	4,498,674	4,081,107	197,846,642	43.98	48.48
1978	3,617,574	3,281,791	156,679,856	43.32	47.74
1977	4,037,901	3,663,103	178,223,078	44.14	48.65
1976	3,946,817	3,580,473	153,001,887	38.77	42.73
1975	3,177,204	2,882,296	115,384,797	36.32	40.03
1974	3,865,780	3,506,958	113,929,564	29.47	32.49
1973	3,480,840	3,157,748	85,727,159	24.63	27.15
1972	2,524,415	2,290,099	57,070,248	22.61	24.92
1971	1,978,731	1,795,065	41,123,878	20.69	22.91
1970	2,418,161	2,193,707	36,634,138	15.15	16.70

Source: Bureau of the Census.

EXPORT PRICE OF DOUGLAS FIR CHIPS FROM PACIFIC NORTHWEST TO JAPAN



Ticks represent first half of year and second half of year except for 1991, where second tick represents the third quarter.

Source: *Pulp & Paper Week.*

U.S PULPWOOD PRICES: CHIPS

Year	West Coast Douglas fir chip, export \$/bdu[1]	South green chip pine, clean \$/ton[2]	South green chip hardwood, clean \$/ton[2]	Louisiana pine \$/ton[3]	Louisiana hardwood \$/ton[3]
1991					
2Q	\$122.00	\$21.59	\$16.14	\$22.21	\$17.74
1Q	122.00	22.05	16.91	21.73	16.58
1990					
4Q	109.40	21.02	16.38	20.81	15.78
3Q	109.40	21.11	16.63	21.11	15.96
2Q	117.00	21.28	16.73	22.15	17.53
1Q	117.00	21.63	16.83	21.51	17.12
1989					
4Q	133.00	21.02	16.66	20.65	16.47
3Q	133.00	20.55	16.03	19.69	15.22
2Q	118.00	19.98	15.80	19.05	16.82
1Q	97.70	20.16	15.70	19.42	16.13
1988					
4Q	86.50	20.51	16.62	19.82	15.14
3Q	86.50	20.56	16.50	20.23	13.77
2Q	79.20	20.34	17.01	20.23	14.91
1Q	79.20	20.84	16.98	20.93	18.28
1987					
4Q	76.70	20.12	17.02	20.29	16.23
3Q	76.70	18.76	14.05	19.05	14.81
2Q	78.40	23.73	18.76	19.95	15.05
1Q	78.40	23.60	18.52	19.88	15.63
1986					
4Q	78.40	22.58	17.55	20.60	15.43
3Q	78.40	22.63	17.49	20.09	14.62
2Q	80.40	23.52	17.65	19.62	14.41
1Q	80.40	24.01	17.71	20.50	14.50
1985					
4Q	82.40	24.04	17.66	20.50	14.30
3Q	82.40	24.29	17.79	21.77	13.92
2Q	85.80	25.83	18.32	21.33	14.20
1Q	85.80	26.22	18.25	n.a.	n.a.
Year end					
1984	81.90	26.18	18.03	20.60	12.93
1983	78.00	25.68	17.64	21.45	14.43
1982	97.00	23.83	16.52	21.63	14.32
1981	103.50	21.82	15.01	18.61	13.50
1980	106.00	19.30	14.72	20.65	13.87
1979	56.00	16.71[4]	12.97[4]	16.50	12.35

n.a. = Not available.

1. F.o.b. vessel to Japan.
2. Average for 13 southern states. Delivery to pulp mill through 1987; f.o.b. sawmill from 1988 forward.
3. F.o.b. sawmill.
4. Average for 11 southern states.

Source: *Wood Fibre Northwest*, *Timber Mart-South*, Louisiana Dept. of Agriculture & Forestry, *Pulp & Paper PriceBook*.

U.S. PULPWOOD PRICES: ROUNDWOOD

($/cord)

Year	South pine[1]	South hardwood[1]	Louisiana pine[2]	Louisiana mixed hardwood[2]
1991				
2Q	$50.17	$40.00	$60.23	$56.77
1Q	46.83	39.51	57.35	47.82
1990				
4Q	46.58	41.17	61.24	49.07
3Q	48.02	41.22	60.08	45.99
2Q	47.98	42.81	59.31	47.69
1Q	48.46	41.32	41.92	48.68
1989				
4Q	49.13	42.70	60.85	50.80
3Q	48.09	40.79	62.46	51.15
2Q	45.04	38.29	48.05	37.52
1Q	45.05	38.11	49.39	n.a.
1988				
4Q	42.90	36.25	54.20	46.13
3Q	43.00	37.12	51.93	45.51
2Q	42.94	35.40	53.76	48.90
1Q	42.84	36.03	49.01	46.80
1987				
4Q	41.67	33.96	51.57	46.28
3Q	41.46	33.73	51.06	44.56
2Q	42.43	34.10	46.56	45.46
1Q	41.55	33.40	53.49	45.05
1986				
4Q	40.91	31.68	48.20	41.21
3Q	39.92	30.64	47.79	34.91
2Q	41.69	31.57	n.a.	n.a.
1Q	43.68	32.20	48.29	30.05
1985				
4Q	45.17	31.89	41.00	35.31
3Q	46.14	31.81	59.63	41.13
2Q	48.97	33.00	47.00	36.00
1Q	49.41	33.20	n.a.	n.a.
Year end				
1984	48.75	32.98	34.83	n.a.
1983	47.72	32.43	45.72	34.33
1982	43.28	31.90	47.08	35.68
1981	40.99	30.60	44.85	34.83
1980	43.32	30.95	39.75	31.96
1979	37.95[3]	30.00[3]	40.80	33.45

n.a. = Not available.

1. Average for 13 southern states. F.o.b. dealer yard.
2. F.o.b. car.
3. Average for 11 southern states.

Source: *Timber Mart-South*, Louisiana Dept. of Agriculture & Forestry, *Pulp & Paper Pricebook*.

United States:

ENERGY USE AND CONSERVATION

The Persian Gulf War again alerted many to the instability created by American industry's dependence on overseas oil, but it was a lesson already learned by the paper industry, which has greatly reduced such consumption since the oil crisis of the 1970s. Through self-generated electricity and cogeneration projects, paper manufacturers will continue to become more self-sufficient; however, the industry in the coming years may be encouraged on two fronts to save scarce capital by relaxing energy efficiency and conservation efforts.

One will be the immediate lure of depressed oil prices for almost unlimited amounts as Iraq and Kuwait attempt to finance the rebuilding of their countries. After hitting just over $40/barrel during the Gulf War, prices in July 1991 returned to an average of $20—where they had been just before Iraq's invasion a year earlier. The other front will be the growth of recycled pulp, which, while consuming less energy, does not provide a usable byproduct (such as black liquor) that serves as a renewable energy source. Thus, while demand will grow for recycled pulp as recycled paper products become mandated, the process's heavy reliance on fossil fuels will continue.

Among influences that will continue to point the paper industry in the direction of self-sufficiency will be legislation to promote and force cleaner and more cost-efficient energy methods. The industry will also appreciate the benefits of cogenerating electricity plants as brownouts and blackouts remain a limited problem in populated areas. In 1991, Georgia-Pacific Corp. installed a monitor at its Brunswick, Ga., mill to ensure that an electricity demand limit is not exceeded during hot weather curtailments. G-P receives a surcharge of $300,000 if any half-hour average consumption rate exceeds the limit during any curtailment.

Other ways the industry can be expected to expand conservation efforts include exploring energy alternatives, increasing uses of wood residues and nonrecyclable wastepaper as fuels, and investing in energy-efficient technologies. On the cutting edge of alternative technologies is the burning of rubber tire chips and pelletized wastepaper. As many as four paper mills in the U.S. were using nonrecyclable wastepaper as fuel as of mid-1990. Most newer boilers can swing between coal, gas, and oil as well as these alternative sources, although concerns remain about the toxicity of burning rubber. Scott Paper Co.'s tissue mill in Winslow,

U.S. PULP AND PAPER INDUSTRY PURCHASED ENERGY COSTS AS PERCENTAGE OF SHIPMENTS

(billion $)

Year	Purchased energy costs*	Value of shipments	As percentage of shipments
1990p	$4.50	$56.40	7.6%
1989	4.40	57.70	7.3
1988	4.00	57.18	7.0
1987	4.18	51.52	8.1
1986	4.25	43.99	9.7
1985	4.83	39.17	12.3
1984	5.05	41.38	12.2
1983	4.84	36.07	13.4
1982	4.71	34.00	13.9
1981	4.76	35.11	13.5
1980	4.03	31.76	12.7
1979	3.27	27.99	11.7
1978	2.70	24.03	11.3
1977	2.55	22.30	11.4
1976	2.19	20.98	10.5
1975	1.88	17.82	10.5
1974	1.65	18.53	8.9
1973	0.93	13.71	6.8
1972	0.81	11.70	6.9

*Includes electric energy, fuel oil, coal, natural gas, and other fossil fuels.
p = Preliminary.
Source: American Paper Institute.

Maine, is a 100% energy self-sufficient operation, using biomass energy sources since the 1960s, according to the company. It achieved a 38% reduction in costs by minimizing waste and will also conform to an Environmental Protection Agency target of 25% waste reduction by 1992.

Cogeneration. Reliance on cogenerated power sources built, owned, and operated by outside contractors has played a major role in lowering spending for power generation projects. The U.S. pulp and paper industry remains a leader in self-generation and cogeneration of electric power, with inplant electric generation increasing 53% over the 1982-90 period, the American Paper Institute reported. Over the same period, cogenerated electricity increased 64%, while electricity sold to utilities increased 892%.

In one of the larger cogeneration projects announced recently, James River Corp. and CRSS Capital formed a joint partnership in 1991 to build a facility that will include a chemical recovery unit, evaporation system, and turbine generator at JR's Naheola, Ala., mill. The $270-million project is slated for completion in summer 1993 and will increase pulp capacity at the tissue and bleached board mill. During 1990, cogenerated electricity represented more than 87% of total inplant electric generation, compared with 81% in 1982, while electricity sold to utilities went up from 2.0% on the 1982 total generation to 13%.

Between 1972 and 1990, the paper industry reduced oil consumption by 66.4%, natural gas consumption by 9.5%, and total fossil fuel and purchased energy consumption by 5.1%, according to API's most recent energy statistics. This occurred while paper industry output increased by more than 57% over the 18-year period. The industry also increased its use of self-generated and residue sources of energy from 40.3% of total energy in 1972 to 56.0% of the total in 1990. Almost 50% of the paper industry's own electricity demand is cogenerated, equivalent to about 24 million barrels of oil, API said.

Still, the U.S. paper industry remains a major user of fuel oil, which accounted for 6.4% of its total fuel use in 1990. In 1972, this level was 22.2%, and it declined to 7.8% in 1989. Natural gas is used almost twice as much as oil in the paper industry, representing 16.3% of total fuel use in 1990. Natural gas, which represented 21.1% of paper industry fuel use in 1972, declined to 14.0% in 1988 but has bumped up a bit since then.

Before the oil embargo crisis of 1972, the U.S. paper industry relied on purchased fuel and energy for 59.7% of its energy needs. It decreased that level to 43.8% in 1989 and to 44.0% in 1990, API statistics show, representing the annual equivalent of saving more than 200 million barrels of oil, or about 27 days of current U.S. oil imports. This occurred while pulp, paper, and paperboard output increased by almost 58% from 1972. The average use of fossil fuels and purchased energy per ton of output was reduced from 19.2 million Btu's in 1972 to 11.5 million Btu's in 1990, an

U.S. PULP AND PAPER INDUSTRY ESTIMATED FUEL AND ENERGY USE

Source	1990 consumption (trillion Btus)	% of total*	1989 consumption (trillion Btus)	% of total*	1988 consumption (trillion Btus)	% of total	1972 consumption (trillion Btus)	% of total*
Purchased electricity	159	6.5%	154	6.4%	155	6.5%	93	4.4%
Purchased steam	19	0.8	18	0.8	21	0.9	23	1.1
Coal	338	13.7	331	13.7	330	13.9	225	10.7
Residual fuel oil	151	6.1	178	7.4	178	7.5	447	21.2
Distillate fuel oil	7	0.3	9	0.4	8	0.3	22	1.0
Liquid propane gas	3	0.1	3	0.1	3	0.1	3	0.1
Natural gas	401	16.3	359	14.9	332	14.0	443	21.0
Other purchased energy	5	0.2	3	0.1	2	0.1	2	0.1
Energy sold	-34	—	-33	—	-39	—	-13	—
Total purchased fossil fuel and energy	1,051	44.0	1,023	43.8	990	41.8	1,243	59.0
Hogged fuel, 50% moisture	248	10.1	250	10.4	263	11.1	42	2.0
Bark, 50% moisture	131	5.3	136	5.7	124	5.2	95	4.5
Spent liquor, solids	967	39.4	944	39.1	928	39.2	700	33.2
Self-generated hydroelectric	17	0.7	13	0.5	11	0.5	9	0.4
Other self-generated energy	13	0.5	11	0.5	11	0.5	3	0.1
Total self-generated and residue fuels	1,375	56.0	1,335	56.2	1,337	56.5	845	40.1
Total energy	2,426	—	2,379	—	2,328	—	2,093	—

Note: Columns may not add to total due to rounding.
*Total excludes energy sold.
Source: American Paper Institute.

efficiency gain of more than 46% on an adjusted basis, API reported.

Yet as a possible indication of some relaxation in conservation methods, 1990 revealed a slight increase in the consumption of fossil fuels and purchased energy of 2.7% compared with the previous year, although this paralleled an approximate 3.3% increase in pulp, paper, and paperboard production. Use of self-generated and residue sources of energy in 1990, at 56.0%, was down from 56.2% in 1989, according to API. While the industry's total use of fuel oils during 1990 was 15.8% below 1989, natural gas use was 11.8% higher in 1990 than in the previous year, also indicating the continued trend toward greater use of gas. Purchased electricity increased in 1990, accounting for 6.5% of energy consumption in the paper industry—0.1% higher than in 1989 and up from 4.4% in 1972, API statistics said.

Coal has taken on the guise of a virtual alternative source of energy, one with more stable pricing than oil or gas. Although coal use faded in the 1960s and has remained stagnant in the U.S. paper industry in the past few years, it now represents 13.7% of the total energy used by the paper industry, compared with 10.7% in 1972. It continues to be a major source of energy for Wisconsin's sizable paper industry and may see a resurgence in use, especially as part of a mix-use energy source. In 1990, coal provided 35% of the energy source for the paper industry in the north central U.S. and 27% for the middle Atlantic states, API reported.

Differences in use. Energy use tends to vary by region, with some areas of the U.S. more vulnerable to changes in oil prices than others. Oil provided 34% of the energy used by the pulp and paper industry in New England—far higher than the 8% average nationwide but down from 36% in 1989 and 66% in 1972. The region accounts for one-third of the industry's oil consumption nationwide, while the south central region used oil for only 1.3% of its energy needs and relied on gas for 23% of its energy sources. Natural gas provided only 6.2% of the energy source for the south Atlantic region, which reduced its dependence on fuel oil from 31% in 1972 to 7% in 1990.

Energy use also differs considerably by grade. Newsprint made primarily from thermomechanical pulp (TMP) uses a considerable amount of energy per ton produced, mainly provided by purchased electricity and fossil fuels. Unbleached kraft linerboard has a lower energy requirement per ton produced, and about half of the energy comes from burning black liquor. Recycling is an added process to an existing mill and therefore increases energy demand. The increased use of TMP and chemi-thermomechanical pulp will dramatically increase electric demand and force more outside power purchases. Although it takes less energy to manufacture a ton of recycled pulp than virgin pulp, recycled pulp does not result in reusable byproducts and creates a sludge that is not easily dewatered and burned.

The U.S. pulp and paper industry marked its seventh consecutive year of record capital spending in 1990, but this spending, which had seen slower growth in recent years, actually decreased in 1991. *Pulp & Paper* magazine's January 1991 survey of spending plans shows that outlays for power plants have dropped steadily from the early 1980s as a fraction of total mill spending, as lower energy costs have allowed manufacturers to shift their attention to other parts of their mills. Over the period 1990-92, paper firms will spend $1.05 billion on energy-related production projects, a 0.5% decrease over the plans for 1989-91. Energy projects account for just 6.9% of 1991 production-related spending, compared with 8.1% in 1989-91 and 10% in 1988-90. Power plant spending is down 22.5% for the 1990-92 period, *P&P* reported.

Equipment. Along with a trend to use higher pressures and temperatures on recovery boilers in cogeneration is a trend toward gas turbines in a search for efficient heat rates. The benefits of gas turbines are lower capital costs and the good economics of natural gas. A combination of gas turbines and heat recovery steam can be used to repower older systems, but the decision remains site specific. The average size of new steam turbines is roughly 40 MW, a 20% increase in the past decade, part of a drift toward single, large-capacity boilers. Boiler projects have greatly decreased over the past few years, with just 15 new boilers planned over 1989-91, compared with 25 installed in 1987-89 and at least 40 during 1985-87. Many new projects are tied in with significant kraft pulp expansion projects.

Independent power producers are increasing their presence in the pulp and paper industry, many as joint ventures. Some are built on mill property and operated with mill personnel. A hindrance to building such plants can be a paper company's desire to expand in phases instead of constructing an entirely new facility. Typically, these plants sell steam to the mill and electricity to a utility. This partly frees the paper company to focus capital investment on actual production processes. Contractual agreements, however, are crucial to the feasibility of such ventures.

In late 1990, the California Energy Commission awarded a contract to Manufacturing & Technology Conversion International Inc., Santa Fe Springs, Calif., to come up with a system to gasify fiber residue (from recycled-paper production) as well as black liquor; the gas can then be burned in modified natural gas boilers or furnaces to produce hot water, steam, and heat.

ENERGY USE PER TON OF PULP, PAPER, AND BOARD PRODUCED

	1990p	1989	1988	1972
Energy consumption (trillion Btus)	2,207.8	2,182.4	2,167.6	1,736.8
Total paper and board production (million tons)	83.3	80.6	80.4	52.7
Energy use/ton (million Btus)	26.5	27.1	26.9	32.9

p = Preliminary.
Source: American Paper Institute.

United States:

TRANSPORTATION

Pulp and paper shipments essentially remain divided at about 60% rail and 40% truck. Competition among rail lines and between rail and trucking continues to increase, with rail generally losing some business to trucking and more recently to shipping. Rail tends to have the advantage on long-haul cargoes, whereas trucking is often better suited for short-haul deliveries and lightweight products, such as sanitary tissue. A brewing controversy in the competition between rail and trucking has been the issue of longer combination vehicles (LCV), perhaps allowing twin 48- or 53-ft trailers on the highways. The railroad industry has come out strongly against the measure, with the Assn. of American Railroads (AAR) estimating that LCVs would divert more than 19% of rail ton-miles, causing an erosion of 41% in pretax profits to railroad companies.

CARLOADINGS OF MAJOR U.S. RAILROADS

(000 cars loaded)

Year	Pulp, paper, and allied products	Primary forest products	Lumber and wood products	Total forest products	All railcar loadings
1990	544	502	319	1,365	17,415
1989	553	523	356	1,432	17,352
1988	638	512	391	1,541	22,140
1987	647	544	419	1,610	20,812
1986	655	532	397	1,584	19,477
1985	712	584	366	1,662	19,574
1984	763	697	372	1,832	20,257
1983	778	739	368	1,885	18,800
1982	829	766	308	1,903	18,498
1981	966	939	397	2,332	21,618
1980	1,060	1,002	469	2,531	22,598
1979	1,097	1,055	597	2,749	23,876
1978	1,094	1,086	649	2,829	23,373
1977	1,103	1,112	675	2,890	23,173
1976	1,101	1,139	670	2,910	23,457

Source: Assn. of American Railroads.

A growing number of U.S. railroads are rebuilding and upgrading their boxcar fleets to carry paper products that are seen as a high-value commodity well suited for dense loadings in high-cube, 100-ton boxcars. And because paper shipments are no longer regulated by the Interstate Commerce Commission, railroad carriers can offer rates competitive with motor carriers to gain business. For paper companies trying to control their distribution costs, rail shipment of large paper volumes becomes an efficient alternative to the spiraling costs of trucking. Revisions in 1991 to Rule 41 truck and rail shipping classifications that permit the use of lighter-weight board as long as it has the required necessary ring crush value could eventually have some implications for the transportation industry.

Rails, ships on paper chase. When rail and truck rates are competitive, however, quality of service becomes the primary criterion for deciding the appropriate mode of transportation. Equipment quality is particularly crucial because paper products are easily damaged in plain boxcars or trucks that have no blocking or bracing aids to anchor cargo. To address these problems, railroads are upgrading their services to capture more of the lucrative paper business. Wisconsin Central, for example, is currently reconditioning all 2,700 boxcars in its fleet, adding protective devices, load restraints, and even cushion-framed boxcars to reduce shipping damage to finished paper goods. Burlington Northern also rehabilitated a number of old, "plain" boxcars to make them more suitable for carrying paper products.

The pulp, paper, and paperboard industry is one of the primary users of boxcar rail transportation, but the rail industry has generally been losing ground in the paper industry. AAR reported a 1.7% decline in car loadings of pulp, paper and allied products in 1990 to 543,806, compared with 553,403 in 1989. This followed a dramatic fall of 13% in 1989, compared with the previous year. Car loadings of pulp and paper products declined 1.6% in third-quarter 1991, compared with the same period in 1989, AAR reported. Railroads have moved to improve the boxcar supply available to paper shippers by creating a national pool of cars that allows a central management company to coordinate use of boxcars from various railroads that might otherwise be empty on return trips. Piggyback traffic, also known as intermodal, trailer-on-flatcar, or container-on-flatcar, has grown in popularity. Figures for the first six months of 1990 showed a 3.5% increase over the same period in 1989.

Ocean transport figures prominently in U.S. wastepaper exports, but overall shipments of pulp and paper have declined recently. After a decade of rate declines for container-ship companies, however, rates promise to increase during the early 1990s, perhaps by as much as 5% to 8% annually. The Transpacific Westbound Rate Agreement has steadily lifted rates for wood and paper products, especially wastepaper exports to Japan.

For some ports in the U.S., forest products are providing steady business. Woodpulp now accounts for 40% of the export volume at the port of Wilmington, N.C., growing 18% annually since 1987. In October 1991 at Morehead City, N.C., the second largest woodchip ship in the world completed it maiden voyage to load chips for delivery to Japan. Georgia-Pacific Corp. said late in 1990 that it had plans to double traffic through the port of Pascagoula, Miss., and it increased exports from its nearby mills. The Port of New York & New Jersey reported a 13% decline in paper and paperboard exports in 1990 to 77,825, compared with 89,994 in 1989, but wastepaper continues to be the principal general cargo of the port, with volume increasing 8.9% to almost 1.3 million tons in 1990. Wastepaper has provided an area of growth for transport companies for several years now, with Andover International Associates forecasting that about 13 million tons of wastepaper will be shipped in the U.S. by 1995, resulting in more new business for freight haulers. In 1990, Burlington Northern inaugurated a service to haul old corrugated containers from the Midwest to Stone Container Corp.'s linerboard mill in Missoula, Mont. For BN, the service represents a lucrative backhaul because it transports linerboard from the mill to Stone customers in those cities.

U.S. RAILROAD FREIGHT PRICE INDEX

(1984 = 100)

Year	Pulp, paper, and allied	% change from previous year
1990	n.a.	n.a.
1989	105.1	0.3%
1988	104.8	4.0
1987	100.6	-0.4
1986	101.0	1.0
1985	100.0	0.1
1984	99.9	4.5
1983	95.6	1.0
1982	94.7	10.8
1981	85.5	11.5
1980	76.7	11.6
1979	68.7	20.5
1978	57.0	5.7
1977	53.9	5.7
1976	51.0	8.3
1975	47.1	13.5
1974	41.5	15.3
1973	36.0	0.3
1972	35.9	1.4
1970	35.4	12.4
1970	31.5	9.0
1969	28.9	n.a.

n.a. = Not available.
Source: Bureau of Labor Statistics.

United States:

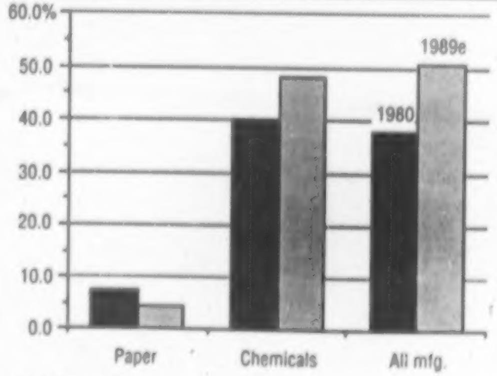
RESEARCH AND DEVELOPMENT SPENDING

In addition to the work done by paper companies, a significant amount of research into papermaking processes and technologies is performed by supplier companies, universities, and government agencies. Suppliers who perform a substantial amount of research work for the industry include manufacturers of papermaking equipment, felts and fabrics, computer control systems, and chemicals. Academic and government groups are particularly active in paper chemistry and forestry.

Leading research institutes specializing in paper science include the Institute of Paper Science & Technology (IPST, formerly the Institute of Paper Chemistry), Atlanta, Ga.; the U.S. Forest Products Laboratory, Madison, Wis.; and the Pulp & Paper Research Institute of Canada (Paprican), Pointe Claire, Que. Typical subjects on the research agenda include forest genetics and reforestation techniques, whole-tree utilization, hardwood pulping processes, water- and air-quality analysis and control, improved energy use and recovery technology, new types of wet and dry forming of paper, computer process control, use of chemicals and fuel from byproducts and waste, and coating and packaging technology.

In the last two years, IPST has made major changes that demonstrate its continuing success after 60 years of education, research, and commitment to the industry. At the end of 1989, IPST moved from Appleton, Wis. (where it had been located for over 50 years), to Atlanta, where it will develop an alliance with the Georgia Institute of Technology.

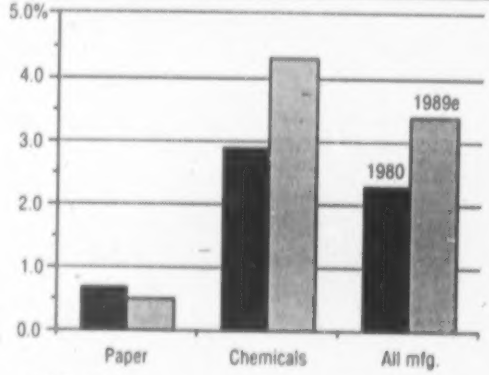
R&D SPENDING PATTERNS, AS PERCENTAGE OF CAPITAL SPENDING



e = Estimate.

Source: Data Resources Inc.

R&D SPENDING PATTERNS, AS PERCENTAGE OF SALES



e = Estimate.

Source: Data Resources Inc.

IPST has constructed a new campus building, purchased a research facility, become accredited, and developed new contacts for pulp and paper research.

Each year, IPST spends more than $7 million to research topics such as impulse drying, online monitoring of paper strength, and clonal propagation of trees. IPST continues to solicit support from federal agencies and paper companies and allied industries. The Office of Industrial Programs of the U.S. Dept. of Energy has been an active sponsor of research related to the paper industry, as has the National Science Foundation (NSF).

To fill the vacuum created by IPST's departure from Wisconsin, the nation's only federal Forest Products Laboratory, located at the Univ. of Wisconsin at Madison, has been inviting paper companies to tour the lab and explore the potential for joint research projects. The lab has a complete research-scale paper mill and is currently working on six areas of research: wood adhesives, composites, fiber product design criteria, fiber processes, pulping chemistry, and analytical chemistry of wood and pulp. The lab has a $17.6-million budget in fiscal 1991, with $8.2 million allocated to pulp and paper research. Although overall federal funding of R&D has lagged behind that of industry since 1980, the federal government does provide 45% of the total funding and government policies affect industrial support of R&D.

Funding for R&D in the pulp and paper industry also comes together through joint projects between supplier companies and research institutions. For example, Beloit Canada, Beloit of the U.S., and Paprican are working to develop a commercial high-temperature pressing system that will employ the principles of impulse drying for newsprint. Beloit is working with IPST on impulse drying on linerboard and on coating. The project will initially focus on newsprint and other uncoated groundwood papers of less than 85 g/m². Beloit spends approximately $20 million annually on R&D—and at times considerably more on special projects.

Paprican's main research focus is on how to expand the uses for mechanical and chemi-thermomechanical pulp in printing papers, tissue, and packaging grades. The institute is researching how to make high-yield pulps with enhanced strength properties and high brightness while also meeting high standards of environmental protection and energy conservation. Paprican is additionally spending much time researching the elimination of dioxins and decreasing the formation of organochlorides in chemical bleach plants.

At this point in the paper industry's development, a large portion of R&D expenditures are lumped together under the rubric of spending on environmental and consumer protection. The National Council of the Paper Industry for Air & Stream Improvement has spent a lot of money researching how trace amounts of dioxin are formed as an unwanted byproduct of bleached kraft pulp processes. It is also paying for risk assessments to prove to consumers that using bleached paper products is safe.

Industry expenditures. R&D spending for the paper and allied industries totaled $611 million in 1987—a 13.6% increase over 1986 and the largest percentage increase of the major industries shown in the accompanying table, according to NSF (NSF has not published an update on R&D spending since 1987).

According to Data Resources Inc.'s (DRI) July 1989 survey of R&D expenditures (the report has been discontinued), the paper industry lags in its ratio of R&D spending to total capital expenditures. R&D outlays came to 6.0% of capital spending in 1988, compared with 55.4% for all manufacturing. As a percentage of paper industry sales, R&D accounted for 0.5% in 1988 and 1989. This compares with a 3.5% level in 1988 and a projected 3.4% level in 1989 for all manufacturers. In dollar terms, DRI estimated that the paper industry spent $676 million on R&D in 1988. Spending in 1989 was projected at $721, rising to $726 million in 1991.

Year-to-year increases in the paper industry compare well with other groups, however. The paper industry raised R&D outlays an average of 10.7%/year between 1977 and 1986, compared with 11.5%/year for chemicals and 11.8%/year for all manufacturing.

The Battelle 1990 forecast estimated that the U.S. paper industry spent $684 million on R&D in 1990, virtually all of which will came from the industry itself rather than from government or nonprofit groups. This compares with a federal funding level of about 31% for R&D in all manufacturing industries. For example, the federal government funds about 10% of R&D in the fabricated metals industry and 38% in electrical machinery and communications.

Total R&D spending in the U.S. is forecast to reach $155.2 billion in 1991, an increase of 3.4% over the $150

R&D SPENDING BY INDIVIDUAL PAPER COMPANIES

	1990 R&D spending (million $)	% change 1990-89	1990 R&D expenditures (as % of sales)	1990 R&D expenditures (per employee)
Boise Cascade	$11.4	3.0%	0.3%	$577.0
Consolidated Papers	5.0	-12.0	0.5	1,060.9
Kimberly-Clark	134.9	14.0	2.1	3,376.4
Mead	33.6	38.0	0.7	1,555.6
Scott Paper	66.2	4.0	1.2	2,149.4
Union Camp	52.1	9.0	1.8	2,453.8
Westvaco	31.3	1.0	1.3	2,082.8
Weyerhaeuser	57.2	-12.0	0.6	1,408.8
Industry composite	391.8	7.0	1.1	2,021.9

Source: *Business Week*

billion that NSF estimates was spent in 1990. Battelle forecasts that costs of performing R&D for U.S. industry as a whole will rise approximately 2.4% from 1990 to 1991, absorbing a portion of the increased funding. Battelle said that trends in overall R&D spending are being affected by the federal government's emphasis on defense programs, with the rate of growth continuing to decline, increased support for energy-related R&D programs, and a slowing in investment due to concern over a real business recession.

Released in mid-1989 by the federal Office of Technology Assessment (OTA), a study of ten manufacturing corporations involved in recent mergers or acquisitions found that high debt leads to reductions in R&D, although it was not the only factor causing a drop-off in corporate R&D spending. The OTA study's conclusions were confirmed by NSF, which focused on mergers and restructuring involving the largest R&D companies and found a 5.3% reduction in R&D spending in current dollars between 1986 and 1987.

Gearing up for 1992. In the opinion of many industry leaders, U.S. pulp and paper companies are not spending enough on R&D to enable them to compete successfully against other industries or against European and Scandinavian manufacturers in their own arena. This shortcoming will become critical as 1992 approaches, when the European Community becomes the world's largest single market. U.S. tissue producers are successfully competing in Europe. In contrast, North American producers of printing/writing papers are finding that their domestic market as well as the European market are being encroached upon by producers from Nordic countries.

U.S. PAPER INDUSTRY R&D SPENDING vs OTHER MAJOR INDUSTRIES

(million $)

Industry	1983	1984	1985	1986	1987	% change 1987/86
Nonferrous metals	$302	$319	$385	$418	$442	5.7%
Stone, clay, and glass	586	705	825	942	1,014	7.6
Chemicals	6,792	7,736	8,310	8,656	9,638	11.3
Paper and pulp[1]	552	594	576	538	611	13.6
Petroleum	2,074	2,245	2,194	1,971	1,885	-4.4
Food and beverage[2]	881	1,234	1,315	1,535	1,400	-8.8
Textile mill products/apparel	150	182	218	246	227	-7.7

1. 1985 data include allied products.
2. Data from 1984 onward include tobacco.
Note: All data were revised in 1987.
Source: Div. of Science Resources Study, National Science Foundation.

United States:

ENVIRONMENTAL SPENDING AND REGULATIONS

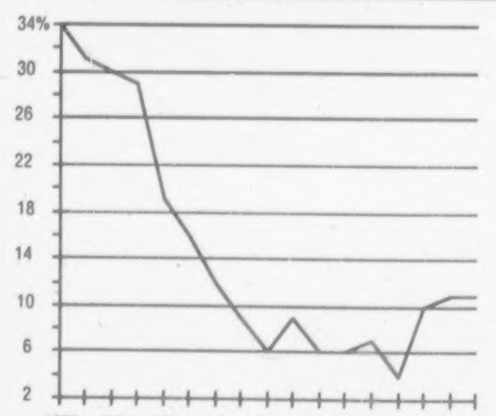
Pulp and paper producers have made considerable progress on the environmental front but will face waves of new and updated regulations in the years ahead. The Clean Air Act was amended in 1990, and both the Clean Water Act and the Resource Conservation & Recovery Act (RCRA) are due for reauthorization by Congress in 1992. Other environmental rules will also be forthcoming.

Environmental protection imposes a significant financial burden on the pulp and paper industry. The bill was expected to reach $1.269 billion in 1990, up 22% from the previous year, according to the latest survey from the National Council of the Paper Industry for Air & Stream Improvement (NCASI).

NCASI estimates that fixed costs for environmental protection facilities, in addition to environment-related corporate administrative and research costs, contributed $22.20 to the cost of each ton of paper and board produced in 1989. Further staff costs and environmental protection operating and maintenance costs could bring that amount up to $35/ton.

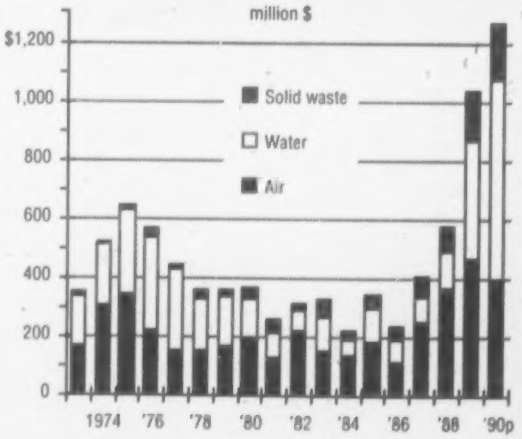
In all, environmental expenditures accounted for 11% of total capital expenditures by U.S. pulp and paper mills in

CAPITAL SPENDING FOR POLLUTION ABATEMENT, AS PERCENTAGE OF TOTAL SPENDING



Source: National Council of the Paper Industry for Air & Stream Improvement.

CAPITAL SPENDING FOR POLLUTION ABATEMENT, BREAKDOWN BY AREA



p = Planned.
Source: National Council of the Paper Industry for Air & Stream Improvement.

both 1988 and 1989. The relative share of expenditures on water, air protection, and solid waste disposal shifts considerably from year to year. In 1989, spending on air quality consumed nearly half of the industry's environment budget, while water quality protection took up more than one-third of the funds. By 1990, however, water issues took more than half of the expenditures, having risen by 69% from 1989. Air quality's share retreated to less than one-third. NCASI attributes the significant increase in water quality spending over the last few years to tighter water quality standards, expansions of pulp mills on water-quality-limited streams, and bleach plant modifications to cut down on chlorinated organics in effluent.

Dioxin. Among the most infamous chlorinated organics are the dioxins, a family of 75 compounds demonstrating varying degrees of toxicity. Control of dioxins, particularly 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD), has been a major issue for the industry since they were first detected on a wide scale in pulp, effluent, and sludge at U.S. bleached kraft pulp mills. The problem came to light in a 1988 study conducted by the Environmental Protection Agency (EPA) and the American Paper Institute (API).

The dioxin 2,3,7,8-TCDD is known to be a virulent carcinogen in lab animals—and this has been the basis for aggressive antidioxin campaigns, but whether or not humans are equally susceptible has been the focus of contentious debate. A federal study released early in 1991 and a dioxin conference held in October 1990 at Cold Spring Harbor Laboratory in Long Island, N.Y., suggest that low exposures may not be dangerous. However, the federal study showed that higher concentrations may be quite harmful, possibly driving up cancer death rates.

U.S. PAPER INDUSTRY ENVIRONMENTAL PROTECTION SPENDING

(million $)

Year	Water	Air	Solid waste	Total	% of total capital spending
1990p	$677	$393	$199	$1,269	—
1989	401	464	174	1,039	11%
1988	129	360	83	572	11
1987	93	242	68	403	10
1986	80	109	48	237	4
1985	121	175	46	342	7
1984	62	130	34	226	6
1983	118	149	60	327	6
1982	81	214	23	318	9
1981	91	120	49	260	6
1980	140	190	38	368	9
1979	178	158	23	359	12
1978	182	149	32	363	16
1977	278	148	17	443	19
1976	319	216	29	564	29
1975	286	341	18	645	30
1974	216	296	11	523	31
1973	179	162	10	351	34

p = Planned.
Source: National Council of the Paper Industry for Air & Stream Improvement.

In part because of such studies, EPA is re-examining the risks of dioxin, and this could lead to revisions in regulations. The paper industry will benefit if EPA's year-long study results in relaxed standards on dioxin, but environmentalists hope the reassessment will lead to more stringent regulations. The Natural Resources Defense Council said it believes EPA has underestimated human dioxin exposure--for example, by using outdated fish consumption statistics. EPA administrator William Reilly acknowledged that the results could go either way, stating that some factors could decrease the level of concern over dioxin risk while others might result in estimates of increased risk.

For the time being, EPA has suggested a limit on dioxin in streams of 0.013 parts per quadrillion (ppq), even though technology is not yet available to detect such low residues. However, individual states are still free to set their own dioxin standards, subject to EPA approval.

EPA and various states are in the midst of issuing wastewater discharge permits—known as National Pollutant Discharge Elimination System (NPDES) permits—to limit dioxin discharges from pulp and paper mills that use chlorine bleaching. Most of the permits for 66 of the mills that have been found to violate water quality standards for dioxin have been issued. Within three years of establishing these permits, the mills must meet water-quality-based effluent requirements developed by the states. Permits at other facilities will be issued as existing permits expire.

EPA is also developing national industrial effluent limit guidelines and standards based on best-available, economically achievable technologies to reduce dioxin contamination and total chlorinated organics from the manufacture of bleached paper products. Those standards will be proposed in 1993 and finalized in 1995 and will entail process changes to prevent formation of dioxin. By 1995, mills will have to comply with whichever of the two types of standards (i.e., water-quality or technology based) is more stringent.

In the meantime, the industry is being held accountable for its dioxin releases by both the government and the private sector. For example, International Paper Co. and Georgia-Pacific Corp. were hit with a deluge of lawsuits related to dioxin released in wastewater from the companies' mills in Mississippi. The cases allege that the paper companies posed a health risk by knowingly dumping dioxin and other pollutants into three Mississippi rivers. Claims totaled $2 billion at the time. In fall 1990, G-P lost the first such case, in which the plaintiff was awarded $1 million, although the company said it intended to appeal.

The I-P mill involved in the larger suit was among 19 pulp and paper mills listed by EPA in September 1990 that were releasing enough dioxin in their effluent to create a significant cancer risk for people eating fish downstream of the mills. EPA also rated the risk from the rest of the 104 pulp and paper mills that make use of chlorine bleaching. The agency suggested that states consider imposing fish

ENVIRONMENTAL LEGISLATION AFFECTING THE PULP AND PAPER INDUSTRY SINCE 1970

1970
Air Quality Standards Act
(Clean Air Act)
(P.L. 91-604)
Water Quality Improvement Act
(P.L. 91-224)
Resource Recovery Act
(P.L. 91-512)
Occupational Safety & Health Act
(P.L. 91-596)

1972
Water Pollution Control Act Amendments
(P.L. 92-500)
Environmental Pesticide Control Act
(P.L. 92-516)

1973
Clean Air Act Amendments
(P.L. 93-15)

1974
Safe Drinking Water Act
(P.L. 93-523)
Clean Air Act Amendments
(P.L. 93-319)

1976
Toxic Substances Control Act
(P.L. 94-469)
Resource Conservation & Recovery Act
(P.L. 94-580)

1977
Clean Air Act Amendments
(P.L. 95-95)
Clean Water Act Amendments
(P.L. 95-217)

1978
Resource Conservation & Recovery
Act Amendments
(P.L. 95-509)

1980
Solid Waste Disposal Act
(P.L. 96-482)
Comprehensive Response, Compensation &
Liability Act (Superfund)
(P.L. 96-510)

1986
Superfund Law
Safe Drinking Water Act Amendments

1987
Clean Water Act Amendments

1989-90
Clean Air Act Amendments

consumption advisories or start site-specific monitoring programs at all streams with a projected cancer risk as high as one in 10,000 or greater. Some of the companies rejected EPA's stance, noting that the statistics were outdated and that a number of the mills had reduced their dioxin levels subsequent to collection of the data.

Producers are using a number of techniques to reduce dioxin emissions, which are closely tied to the amount of molecular chlorine used during the first pulp bleaching stage. But dioxin is not the only chlorinated organic of concern. The reaction between chlorine compounds and lignin during the first stage of bleaching kraft pulps produces a whole family of chlorinated organic compounds that are measured as adsorbable organic halide (AOX).

Both dioxin and AOX formation increase with the amount of chlorine used in the C (bleaching) stage, and AOX is also dependent on the extent of delignification during this step. Thus, production of these byproducts can be reduced by limiting chlorine use and delignification in this stage. This can be done by oxygen delignification or extended cooking before the chlorination stage, better brownstock washing, substituting chlorine dioxide for chlorine during the chlorination stage, or spreading delignification over the C and E (extraction) stages by adding oxygen and/or hydrogen peroxide to the E stage.

Another technique to cut down on chlorine use is biobleaching, in which enzymes are used to enhance delignification before the chlorination stage of bleaching. Or chlorine can be avoided altogether by bleaching with oxygen, hydrogen peroxide, and ozone.

Union Camp Corp. has developed what it says will be the first commercial process to use ozone rather than elemental chlorine as a pulp bleaching agent. The technology will be installed at the firm's Franklin, Va., uncoated freesheet paper mill, which is due to be finished late in 1992. The four-stage sequence involves oxygen delignification, ozone bleaching, and conventional caustic extraction and chlorine dioxide steps. The process permits very large reductions in the amount of water used as well as in color and biological oxygen demand (BOD) in the effluent and in the amount of total chlorinated organics formed. Dioxins reportedly are "virtually eliminated." Operating costs are said to be competitive with conventional bleaching methods.

Dioxin can also be cut by drawing out the bleach process. Scientists at North Carolina State Univ. working with EPA found that adding chlorine continuously in small amounts, rather than in a single step during pulp bleaching, halves the production of dioxin and other chlorinated byproducts. The technique takes about the same amount of time as a single-shot bleaching process.

Another option is to remove dioxin from mill effluent. Biological treatment of mill effluent reportedly eliminates 25% to 60% of AOX before discharge, and this can be supplemented by other techniques. Pope & Talbot Inc. has linked up with Oregon State Univ. in Corvallis for a five-year pilot study on wetland treatment of secondary-treated effluent, which removes total suspended solids (TSS) and BOD. Primary and secondary treatment technology already in place at the company's bleached kraft pulp mill in Halsey, Ore., removes about 45% of the dioxins produced during pulp manufacture. The wetland treatment theoretically can remove 60% of the remaining dioxins from the effluent because they are filtered out with the TSS, according to Roger Campbell, technical manager of the fiber division. The study involves passing effluent by means of gravity and pumps through a diked marsh that P&T created on more than six acres of land. Residence time in the marsh ranges from a half day to two days.

J. Richard Presley of Interox America noted that conventional kraft pulp bleach plants using less than 20% chlorine dioxide substitution for straight chlorine produce between 4 and 8 kg AOX/ton of pulp, while 100% chlorine dioxide substitution would yield 1.36 kg AOX/ton. Countries such as Canada and Sweden have set effluent discharge limits at or below 1.5 to 2.5 kg AOX/ton of pulp produced. In the U.S., state regulations on these chemicals could be developed as soon as 1993.

Clean Water Act. Reauthorization of the Clean Water Act came under consideration by Congress in 1991, but the legislature will probably not vote on revisions to the act before October 1992. The Clean Water Act regulates the discharge of pollutants into U.S. water bodies, primarily through permits that apply to industrial discharges and to publicly owned treatment works.

Senator Max Baucus (D-Mont.) sponsored a bill in mid-1991 to serve as a basis for reauthorization of the act. The proposed legislation would require permit applicants to develop plans to reduce or eliminate discharges and would set up audits to track whether or not industrial facilities were complying with their permits. It would also strengthen EPA's ability to prohibit harmful discharges as well as allow the agency periodically to reconsider existing effluent guidelines.

EPA standards on the treatment and control of storm water runoff went into effect in December 1990. During 1991, U.S. pulp and paper mills were due to apply for storm water permits, either from state agencies with NPDES permitting authority or through regional EPA offices.

Clean Air Act. Late in 1990, Congress passed a clean-air bill updating the 1970 Clean Air Act, which had been last amended in 1977. The wide-ranging legislation includes ozone-protection measures and smog controls. Acid rain provisions will cut sulfur dioxide pollution and set limits on nitrogen oxide emissions.

The new law will also require plants to reduce emissions of 189 toxic and cancer-causing substances (including chloroform) by 90% over the next decade. EPA must identify categories of major sources of these 189 air toxics by November 1991 and develop standards over the next several years for controlling these emissions. NCASI indicated EPA plans to propose standards for the pulp and paper industry in mid-1993. If these measures do not prove to be sufficient to protect public health, more stringent standards will eventually be set in place. EPA was also scheduled to establish a framework of minimum requirements by November 1991 that states can use to set up air pollution provisions of their permitting programs. By the mid-1990s, most major facilities emitting these toxics will begin applying for these permits. API estimated that the toxic chemical provision of the clean-air bill could cost the pulp and paper industry $1 billion/year.

Other pollution-prevention measures are afoot. Under an EPA plan that came out in mid-1991, companies that significantly cut toxic air emissions more quickly than required by the Clean Air Act amendments could get compliance extensions on further pollution controls.

And EPA administrator Reilly developed the Industrial Toxics Project. Under this program, companies that emit any of 17 high-priority toxic chemicals (including chloroform) to water, land, or air are being encouraged to voluntarily cut those emissions 50% from 1988 baseline levels by 1995.

Solid waste. Solid waste, like toxic discharges, is coming under greater scrutiny as consumers, regulators, and manufacturers become increasingly "green." Solid wastes produced by U.S. pulp and paper mills exceed 12 million tpy, with most being dewatered primary and biological sludges that traditionally have been landfilled. As landfilling regulations have tightened, incineration has become more popular, although the disposal problem is then transferred to resultant ash.

Recyclers are looking into new ways to use or dispose of sludge. Fort Howard Corp., which makes recycled tissue, is involved in a pilot program with GranTech, which converts sludge from the tissue company into a carrier for herbicides, pesticides, and fertilizers. Paper Service Ltd., Hinsdale, N.H., is working with Northeast Consultant Inc., an environmental engineering firm based in Barre, Mass., to use sludge to cap existing landfill sites because the sludge contains about 80% clay residuals in addition to short woodfibers. Smurfit Recycling Co. sometimes uses recycling sludge as a soil enhancer because the firm's sludge contains mostly cellulose. Wausau Paper Mills Co. sends some of its primary and secondary (waste-activated) sludge from its bonds and fine printing paper mill in Brokaw, Wis., to Bio-Technology Inc. to be converted to fuel pellets. Potential customers include the power generation industry, which could use the pellets with coal in boilers.

Recyclers can also try to minimize the amount of sludge they produce. Green Bay Packaging Inc., for example, makes packaging products by repulping wastepaper but skipping the deinking and/or bleaching stages and the waste associated with them.

As with air and water pollution, EPA plans to increase its oversight on solid waste. In 1991, the agency proposed regulations on land application of sludge generated by pulp and paper mills that use chlorine or chlorine derivatives for bleaching. Following a comment period, appropriate changes will be made, if necessary, and the rule could go into effect within about two years. EPA may also put forward regulations for landfill and surface impoundment of sludge. The agency's solid waste branch headed up a group that was to decide by October 1991 whether or not such a rule is necessary.

In a modification of RCRA, the method used to determine whether waste should be treated as hazardous or not was changed in September 1990 and will likely result in more waste being considered hazardous. In addition, the list of chemicals whose presence above a specified level puts a waste in this category was extended. Chloroform was among the newly included chemicals. In mid-1990, EPA also came up with standards for treating waste prior to land disposal for the remainder of a group of hazardous substances listed under RCRA, as well as five new wastes—including a dioxin waste. The regulations are being phased in between 1990-92.

The House and Senate are both working on a number of bills dealing with different aspects of RCRA reauthorization. RCRA covers hazardous and solid waste management, cleanup of contamination, and conservation of material and energy. Senator Baucus, chairman of the Environmental Protection Subcommittee with jurisdiction over RCRA legislation, introduced a reauthorization bill in April 1991 that promoted recycling and source reduction of wastes and encouraged states to manage their own waste. The Senate began hearings on RCRA reauthorization early in June, including Baucus's bill, but House leaders had not come up with a bill of their own at that time.

United States:

PAPER MACHINERY

A fifth straight year of increased shipments in paper machinery is expected for 1991 as a result of the continuation through 1990 of a high level of capital spending and a large backlog of orders at major paper machinery manufacturers. Although new orders should slow down in 1991, the long lead times required for most paper machinery products should delay a major impact on shipments until 1992. Product shipments are forecast to rise 4% in 1991, according to the Dept. of Commerce, while exports and imports should increase modestly, about 5%.

The U.S. paper machinery industry finally began to recover in 1986 from the battering it took after the recession of 1982. Record capital spending by pulp and paper companies at home and abroad lifted machinery shipments and trade to new highs. Domestic paper machinery manufacturers shipped products worth $1.3 billion in 1986, the first year to exceed the prerecession high. The industry has seen double-digit increases every year since. Still shaken by their experiences in the early 1980s, however, manufacturers have been slow to add new production capacity. In recent years they have focused on R&D and improved service.

The sharp rise in paper machinery shipments since 1986 is substantially attributable to a steep rise in capital spending by the paper industry, which doubled from $8.54 billion in 1987 to an estimated $17.36 billion in 1990. As of mid-1990, according to the Dept. of Commerce, the U.S. paper industry reported an 11.3% increase in its planned new capital spending for 1990. After initially hesitating to expand,

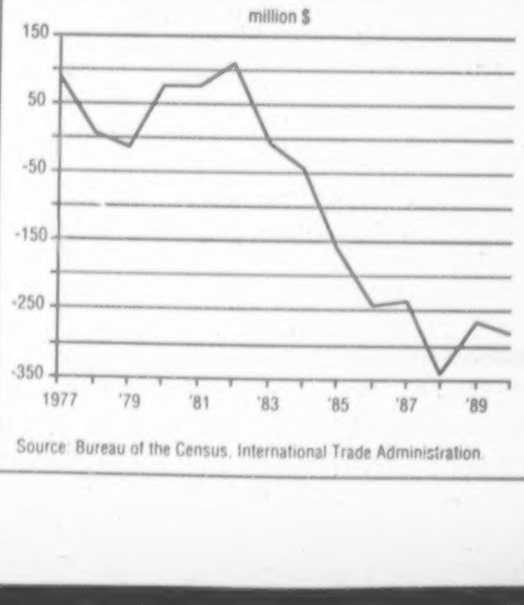
AD VALOREM TARIFFS CHARGED BY VARIOUS COUNTRIES ON IMPORTS OF PAPER AND BOARD MANUFACTURING MACHINERY

(Brussels Tariff Nomenclature 84-31)

Country	Current
U.S.[1]	Duty-free
Finland	5.10%
European Community	3.80%
Canada[2]	9.20%
Japan	
Paper	3.90%
Board	3.40%
Brazil	
If PM is made in Brazil	40.0% + 5% V.A.T.
PM not available in Brazil	20.0% + 5% V.A.T.

1. TSUS 66800.40 except for certain codes with tariffs of 2.4% (i.e., dryers and other specialized parts).
2. Tariff on U.S. machinery will be eliminated by 1993.

U.S. PAPER MACHINERY BALANCE OF TRADE



Source: Bureau of the Census, International Trade Administration.

major paper machinery producers announced capacity increases and new R&D facilities. U.S. paper machinery shipments rose an estimated 3.5% in 1990, to $2.7 billion. To meet the additional demand, manufacturers have turned to widespread subcontracting.

Production and sales in the paper machinery industry have been affected by environmental concerns, particularly recycling. As states pass legislation requiring paper products with higher recycled-fiber content, new demand is created for equipment used to process and recycle paper. U.S. suppliers have captured a large share of the deinking systems and other equipment used in processing wastepaper.

U.S. exports of paper machinery continued an upward surge in 1990 with a 55% increase to $720 million. The lower-value dollar since 1985 has assisted U.S. exports while also contributing to the expansion of foreign-owned paper machinery firms in the U.S. The export upturn was fueled by increased trade with Canada and Mexico and shipments to a wider number of non-North American markets. Several U.S. producers have recently sold equipment or bid on contracts for Eastern European mill projects, although competition from Finland and Germany is intense.

Canada is the principal export market for U.S. paper machinery makers, and Canadian newsprint producers are being affected by the increased demand for recycled newsprint. Only two Canadian mills that process recycled paper were in operation at the end of 1990. Canada exports most of its virgin newsprint to the U.S. and must increase its recycled paper capacity significantly if it plans to retain market share in the face of the requirements set forth in U.S. legislation.

Import growth has slackened but not enough to eliminate the deficit of trade since 1982-83. Imports are forecast to rise 15% to just over $1.1 billion in 1990, according to the Dept. of Commerce. After a 41% increase in 1988, imports of paper machinery reached $904 million in 1989, an 18% increase and a new record high. The increased level reflects strong demand and success by foreign firms in securing additional U.S. orders. The traditional import sources—Germany, Canada, Finland, Japan, and now Brazil—will provide the bulk of paper machinery imports.

The first half of the 1990s holds major challenges for the paper machinery industry in maintaining the current export expansion. Production of machinery and equipment used for rebuilding mills will see good growth, according to the Dept. of Commerce, because of its role in keeping costs down. U.S. exports to Canada will continue to benefit from the Free Trade Agreement, which provides for a five-year phaseout (1989-93) of paper machinery tariffs in both directions. And Canada's need for deinking systems and other recycled paper processing equipment should further enhance U.S. exports in the coming years.

Further projects in Eastern Europe are also likely as the paper industry there seeks to overhaul its antiquated paper mills and meet new demands for newsprint and writing-grade stock created by the transition to a market economy. Additionally, U.S. producers have begun to compete for paper machinery sales in the Soviet Union as it seeks to upgrade its paper industry.

The U.S. is the world's largest producer of paper machinery, with shipments about four times as high as the next level of producers—Canada, Finland, and Germany. On a somewhat lower level are the U.K., France, and Italy, followed by Sweden, Switzerland, Brazil, and Japan. Of this group, Japan and Brazil showed the most rapid growth in capacity during the past decade.

German manufacturers were the dominant force in the world market during the 1980s. In 1985 alone, their exports of $644 million exceeded those of U.S., Italian, and Japanese manufacturers combined. The U.S. has maintained its hold on second place, with a share that declined from 15% in 1981 to 10% in 1985. Over the same period, Japan and Italy raised their shares of world exports to third and fourth place, respectively.

The U.S. balance of trade in paper machinery declined throughout the 1970s, culminating in the industry's first deficit in 1979. After recovering in 1980-81, the trade balance turned negative again following the recession of 1982. Exacerbated by the strong U.S. dollar, the deficit hit bottom in 1986 at $242 million.

Machinery parts and box-making machinery were the major contributors to the deficit during the 1982-86 period, according to the Dept. of Commerce. Over that five-year period, exports of machinery parts fell from $179 million to $169 million, while imports rose from $97 million to $197 million. This translated a surplus of $72 million into a deficit of $28 million. Box-making exports rose slightly from 1982 to 1986—from $19 million to $22 million, but imports shot up from $37 million to $92 million during the same period.

CATEGORIES OF PAPER MACHINERY*

Wood preparation. Machinery involved from the receipt of rough wood at the mill yard to delivery of prepared wood or chips to the pulp mill.

Pulp manufacturing. All equipment required for processing wood or other raw fiber into pulp for delivery to stock preparation, including chemical recovery equipment.

Pulp refining. Processing of pulp fiber for delivery to the paper machine(s).

Paper and paperboard manufacturing. From the headbox through the machine winder.

Finishing. Supercalenders, winders, sheeters, and sheet and roll wrapping equipment.

Converting. Coaters, laminators, embossers, saturators, corrugators, and fabricating equipment . . . boxes, cores, bags, envelopes.

*Based on classification scheme proposed by the Pulp & Paper Manufacturers' Assn. for use by the Bureau of Census in collecting statistical information.

Three price-related factors hindered U.S. paper machinery exporters in the early 1980s: the strong U.S. dollar, effective foreign export financing arrangements, and lower foreign production costs. Since 1985, however, the decline in the dollar and improved credit arrangements by Eximbank have strengthened the U.S. trade balance. In order to sustain competitiveness over the long term, U.S. manufacturers must invest heavily in productive capacity and in R&D, areas in which the industry has been matched or outpaced by overseas competitors.

Trade in papermaking machinery is quite sensitive to exchange rates, with a one- to two-year lag in their effects on trade. While the strong dollar helped foreign suppliers make inroads in the U.S. market during the early 1980s, it also depressed exports of U.S. machinery. The weaker dollar of the late 1980s gave a strong boost to U.S. manufacturers' exports and encouraged overseas suppliers to establish bases in the U.S. as the best way to maintain their newly won market share. Foreign companies, primarily Finnish and German, have used acquisitions, joint ventures, and licensing agreements to produce machinery in the U.S. that formerly was imported. Foreign firms have also invested substantially in parts-stocking facilities in the U.S., hoping to improve the quality of service to customers. The U.S. will probably continue to suffer a negative trade balance in the paper machinery area for several years as imports continue to rise, although at a slower pace.

U.S. machinery makers sometimes compete with their own overseas operations. Many companies, both U.S. and European, have established foreign manufacturing subsidiaries and licensees to take advantage of cheap labor, proximity to major markets, or government incentives. Such moves tend to blur the distinctions between countries of origin. Thus, a contract for a new paper machine to be installed in Canada was awarded in 1987 to the Brazilian subsidiary of a European manufacturer. And earlier in the decade, a new paper machine installed in the U.S. was supplied by the Japanese licensee of a U.S. manufacturer.

The U.S. phased out tariffs on imported pulp and paper machinery in 1987, except for a 2.4% toll on certain machine components, such as dryers and other specialized parts. U.S. suppliers are still subject to tariffs in many countries, including Finland, Canada, the European Community, Japan, and Brazil (Canada's old 9.2% tariff on U.S. paper machinery will be phased out by 1993).

Mergers and acquisitions. Industry consolidation continues apace as both U.S. and foreign firms seek mergers and acquisitions primarily designed to position them to compete effectively in the U.S. or post-1992 EC markets. In 1986, Harnischfeger purchased Beloit, the largest U.S. paper machinery maker. An infusion of capital allowed Beloit to expand and modernize its facilities, and since then the company has taken advantage of the capital spending boom in the paper industry. Beloit operates manufacturing plants in five countries: the U.S., Canada, the U.K., Italy, and Brazil. Through its Brazilian operation, in particular, Beloit has offered government-supported financing and export incentives that make it easier to compete with other paper machine makers. Beloit also maintains licensing agreements with manufacturers in several countries, most notably Mitsubishi Heavy Industries of Japan.

Black Clawson, the second-largest U.S. pulp and paper machinery manufacturer, remains independent. Owned by closely held Parsons & Whittemore Inc., Black Clawson has manufacturing operations in the U.S., Canada, France, and the U.K.

Two of the top pulp machinery manufacturers were combined in 1986. Combustion Engineering purchased the Sprout-Waldron Div. of Koppers and merged it with its C-E Bauer unit, creating C-E Sprout-Bauer. In early 1987, Combustion Engineering extended its reach into the paper machinery market with the purchase of AccuRay, one of the largest U.S. makers of process control equipment. Also in early 1987, Beloit formed a sales alliance with Measurex,

MANUFACTURERS BY COUNTRY OF NEW PAPER MACHINES STARTED UP IN U.S., 1983-90

(Number of machines)

Manufacturer	1983/84	1985	1986	1987	1988	1989	1990	Beyond 1990	Total
Beloit (U.S.)	3	1	4	2	3	2	5	6	26
Manchester (U.S.)	—	—	—	1	—	—	—	—	1
KMW (Sweden)	—	—	—	—	—	—	—	—	0
Sulzer-Escher Wyss									0
(Germany)	—	1	1	—	—	1	2	1	6
Tampella (Finland)	—	1	—	—	—	—		1	2
Valmet (Finland)	1	—	1	—	1	2	5	5	15
Voith (Germany)	1	1	2	1	2	1	2	1	11
Total U.S.	3	1	4	3	3	2		6	27
Total foreign	2	3	4	1	3	4		8	34

Source: *Pulp & Paper Project Report.*

the other large process control supplier. Measurex struck a similar deal with Mitsubishi of Japan in late 1988.

Among foreign suppliers, Sunds Defibrator (a subsidiary of Svenska Cellulosa of Sweden) acquired Rauma-Repola's chemical pulping division in 1988 for an undisclosed amount. In 1987, Sunds tried to buy the Impco Div. of Ingersoll-Rand of the U.S., but that deal fell through when the Federal Trade Commission expressed concern about the merger and Ingersoll decided not to pursue the discussions.

Early in 1986, Valmet of Finland and KMW of Sweden formed Valmet-KMW to manufacture paper machinery. The company is based in Sweden and is 75% owned by Valmet and 25% owned by KMW. Valmet produces paper machines for newsprint and fine papers, while KMW manufactures tissue machines, kraft packaging paper machines, and pulp drying machines. Valmet also acquired some of Wärtsilä's facilities in the U.S.

In 1987, Bird of the U.S. and Sulzer Escher Wyss of Ravensburg, Germany (a unit of Sulzer Group of Switzerland), entered into a multimillion-dollar joint venture, creating Bird Escher Wyss. The venture sells pulp and paper machinery and systems of both companies in North America, and it will develop new systems for sale worldwide. In August 1989, Bird agreed to sell its 49% stake in the joint venture to Sulzer.

In May 1988, Valmet integrated Valmet-Dominion, Valmet-KMW, and Valmet-Appleton into a single North American division to improve its service to pulp and paper customers. Valmet has also invested heavily in its Brazilian subsidiary to diversify into making equipment for paper production and automation.

In August 1989, Sulzer Escher Wyss and privately held Voith agreed to merge operations in the areas of paper technology and fluid flow technology, citing increased globalization in the field and the tendency toward increased concentration in the industry. Later in the year, Asea Brown Boveri Group announced plans to acquire Combustion Engineering for $1.6 billion.

In 1990, Ahlstrom of Finland purchased Sandy Hill Corp. and acquired a controlling interest in the Kamyr group. Measurex and Harnischfeger Industries strengthened their relationship in the process control area with an agreement under which Harnischfeger will own up to 20% of Measurex. In July 1990, instrumentation and controls maker Foxboro agreed to a $656-million merger with Siebe of the U.K.

PAPER INDUSTRIES MACHINERY SHIPMENTS, EXPORTS, AND IMPORTS, 1977-91

(million $)

				Ratios	
Year	Shipments[1]	Exports	Imports	Imports/ new supply[2]	Exports/ shipments
1991f	n.a.	$844	$717	n.a	n.a.
1990	$2,454e	599	880	0.264	0.244
1989	2,238	494	962	0.301	0.221
1988	1,832	426	768	0.295	0.233
1987	1,581	308	544	0.256	0.195
1986	1,296	269	511	0.283	0.208
1985	1,152	251	411	0.263	0.218
1984	1,130	259	301	0.210	0.229
1983	1,021	203	210	0.171	0.199
1982	1,199	316	207	0.147	0.264
1981	1,177	351	273	0.188	0.298
1980	1,177	318	242	0.171	0.270
1979	1,017	233	246	0.195	0.229
1978	799	192	184	0.187	0.240
1977	698	184	95	0.120	0.264

e = Estimate.
f = Forecast (1991 forecast is projected from half-year figures).
n.a. = Not available.
1. Value of paper machinery produced by all U.S. industries.
2. New supply = product shipments + imports.
Source: Census Bureau, International Trade Administration.

All dollars in the Canadian chapters are Canadian unless otherwise specified.

Canada:

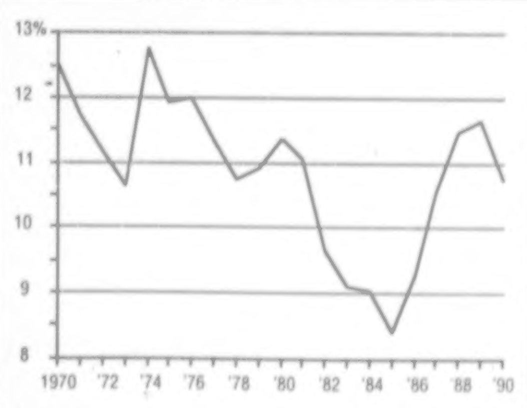
INDUSTRY STRUCTURE

Pulp, paper, or paperboard is manufactured in Canada by 69 separate operating companies. According to Canadian Pulp & Paper Assn. (CPPA) definitions, these companies operated, in sum, 144 pulp and paper mill sites, of which 29 made just pulp, 84 made pulp and paper, and 31 made just paper.

National significance of the pulp and paper industry. Pulp and paper, as well as other forest products, is a long-established and important industry in Canada. In 1950, the industry accounted for 5.3% of Canada's GNP. More recently, CPPA estimates that the industry's contribution was C$22.75 billion in 1990 and $21.5 billion in 1989, accounting for 3.48% and 3.42% of GNP, respectively.

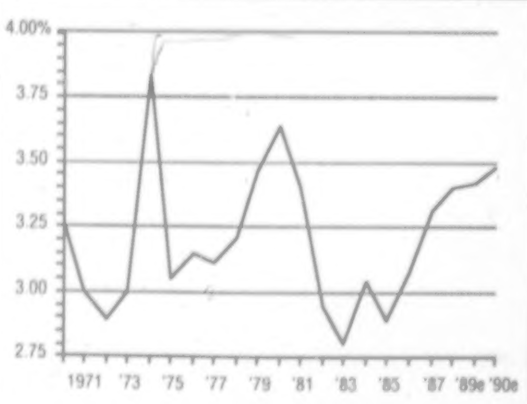
Based on data provided by Statistics Canada for 1987, the latest year for which information is available, the pulp and paper industry is Canada's largest manufacturing industry in terms of employment, wages, and value added (value added measures the increase in worth provided at the mill level). Salary per employee in the paper industry tallied $38,760 vs an average of $34,860 for eight other major manufacturing industries. Value added, meanwhile, equaled $110,185/employee, suggesting payments to the work force absorbed about 35% of additional worth created by the industry. (It should be noted that the value added per employee varies significantly from year to year as it is closely tied to end-product pricing, which was favorable for pulp and paper products in 1987.) In comparison, eight other leading manufacturing industries attained an average value added

SHARE OF PULP AND PAPER EXPORTS TO TOTAL CANADIAN EXPORTS



Sources: Statistics Canada.

SHARE OF PULP AND PAPER PRODUCTION TO CANADIAN GNP



Sources: Statistics Canada; Canadian Pulp & Paper Assn. estimates.

of almost $78,000/employee in 1987, with work force costs absorbing 45% of the additional worth created by these businesses.

INDUSTRY GROWTH

The CPPA *Reference Tables* indicate that pulp and paper has maintained its position as the leading manufacturing industry despite a contraction in employment during the last decades. In 1965, the industry employed 70,000 persons and ran 132 pulp and paper mill sites. Growth was steady over the next decade as employment rose 20% to 84,000 persons and the number of mill sites increased by more than 11.3% to 147. The industry hovered near these levels for the next seven or so years, until the recession of the early eighties shook out a number of less-efficient producers and forced companies to tighten belts and reduce labor forces. By 1983, the number of active pulp and paper mill sites had slipped back to 137, and employment, after peaking at 88,000 in 1981, plunged more than 10% to about 79,000 persons. Over the next five or so years, the industry edged back, and as of 1988, the most recent year for which information is available from CPPA, employment stood at 81,058 persons, earning an average of $41,105 and operating a total of 145 pulp and paper mill sites.

PULP, PAPER, AND BOARD MILLS IN CANADA

(Number of mill sites)*

	Paper/board mills[1]	Pulp mills
Alberta	4	7
British Columbia	13	33
Manitoba	4	5
New Brunswick	7	13
Newfoundland	3	5
Nova Scotia	4	6
Ontario	35	34
Quebec	55	69
Saskatchewan	2	1
Total	**127**	**173**

*One or more pulp mills may be located at the site of a paper/paperboard mill. Total pulp mills shown.

1. Molded pulp products not included in tabulations.

Source: *1991 Lockwood-Post's Directory*.

In the meantime, despite the decline in employment and the number of mill sites, Canada's total pulp, paper, and paperboard capacity has increased steadily, from 37,010 million tons in 1980 to 42,788 million tons in 1988. This apparent anomaly is due to the construction of increasingly large, capital-intensive paper machines.

GEOGRAPHIC BREAKDOWN

The province of Quebec is the capital of Canada's pulp and paper industry. In 1990, Quebec accounted for 44% of the country's paper and paperboard mill sites and 42.1% of production. Quebec also laid claim to 31.6% of Canada's pulp production.

British Columbia is the second largest producer in Canada. The most important product here is pulp. British Columbia was a close second in pulp production in 1990, with

TEN LEADING CANADIAN MANUFACTURING INDUSTRIES, 1987[1]

	Number of employees	Wages (000 C$)	Value added (000 C$)	Value of shipments (000 C$)	Wages per employee	Value added per employee	Value of shipments/ person
Pulp and paper mills							
Newsprint	40,169	C$1,572,126	C$4,165,083	C$8,537,413	C$39,138	C$103,689	C$212,537
Pulp	18,202	757,449	2,954,895	5,817,281	41,614	162,339	319,596
Other	21,963	784,401	1,731,569	4,030,120	35,715	78,840	183,496
Total pulp and paper mills[2]	80,344	3,113,977	8,851,547	18,384,814	38,758	110,171	228,826
Motor vehicle	52,034	2,116,371	4,751,310	39,093,195	40,673	91,312	751,301
Petroleum products	13,252	647,779	1,860,061	16,958,489	48,882	140,361	1,279,693
Meat and poultry	31,578	851,868	2,026,163	9,811,054	26,977	64,164	310,693
Sawmill and planing mills	61,980	1,919,851	3,887,787	8,862,110	30,975	62,726	142,983
Other primary steel industries	42,818	1,682,778	3,232,846	7,999,969	39,301	75,502	186,837
Nonferrous smelting, refining	29,397	1,149,582	3,050,899	5,763,398	39,105	103,783	196,054
Industrial organic chemicals	9,853	460,229	1,657,111	5,118,259	46,710	168,183	519,462
Other commercial printing	50,422	1,327,769	2,252,407	4,486,046	26,333	44,671	88,970
Total	371,678	13,270,204	31,570,131	116,477,334	35,703	84,939	313,382

1. Latest available.

2. In 1988, pulp and paper mills employed 81,058 persons and wages tallied $3,331,900.

Source: Statistics Canada.

a 29.8% market share. Much of the pulp capacity has come on relatively recently, in part reflecting increased export activity to the Far East. Consequently, the mills in British Columbia are, on average, larger than their rivals in eastern Canada. Even so, British Columbia's focus on pulp production is causing major difficulties for local industry during the current market downturn, after having led to lucrative times in the late 1980s.

Ontario, the third largest producer in Canada, is tilted to paper and paperboard production, accounting for 24.7% of Canada's paper and board production and 18.3% of its pulp production. In 1990, the remaining provinces together manufactured 2.48 million tons of paper and board, or 15% of Canada's total paper and board output, and 4.632 million tons of pulp, or 20.3% of national output.

PRODUCT LINE BREAKDOWN

The largest segments of the Canadian industry are newsprint and woodpulp. In 1987, the latest year for which information is available, Statistics Canada reports that newsprint accounted for 46% of the dollar value of the industry's shipped goods, market pulp accounted for 32%, and the largest share of the remaining 22% came from printing and writing papers.

Canada is the world's largest producer of newsprint, with 1990 production 51% more than that of the U.S., its closest rival and largest customer. This ranking is reversed in the case of woodpulp production. As the world leader, in 1990, the U.S. produced two and a half times as much pulp as Canada. But whereas the great majority of woodpulp produced in the U.S. is consumed domestically, more than one-third of Canada's woodpulp production is shipped across its borders, so Canada is by far the largest exporter of pulp in the world (in 1988, Canada accounted for an estimated 32% of all international shipments, and although the figures for 1989 and 1990 are not in yet, that percentage has probably remained close to the 30% mark).

Printing and writing papers, meanwhile, is fast becoming a more important grade in Canada as producers are shifting their production to higher-value-added products.

END MARKETS

Exports, representing 75.45% of all shipments in 1990, are far more important to the Canadian industry than domestic shipments. While 24.6% of Canada's 1990 pulp and paper shipments stayed inside the country, the major market for Canada's production was the U.S., accounting for about 50.9% of total shipments. Other leading destinations included Western Europe, 9.0%; Japan, 4.2%; the U.K., 2.9%; and Latin America, 2.2%.

The pulp and paper industry makes an enormous contribution to Canada's balance of trade. In 1990, pulp and paper exports brought in C$15.17 billion, or 10.8%, of Canada's total export dollars. Indeed, pulp and paper exports were Canada's most important generator of export revenues until 1983, when they were eclipsed by the automobile industry, which remains number one and accounted for 22.3% of export dollars in 1990.

Going forward, the gradual scaling back and eventual elimination, in 1993, of tariffs as dictated by the Canada-U.S. Free Trade Agreement and the General Agreement on Tariffs & Trade should be a positive force for certain Canadian exporters, such as printing and writing paper producers. But by and large, the impact is going to be limited since no tariff exists on Canada's two most important export grades, newsprint and market pulp.

Canada:

PRODUCTION, EXPORTS, AND IMPORTS

Canada is a major pulp and paper producing country heavily geared to exporting, especially to the U.S. In 1990, total Canadian production was 39.4 million tons, of which 35% was paper, 7% paperboard, 16% market pulp, and 42% nonmarket woodpulp. Total export tonnage tallied roughly 20.2 million tons, of which 39% was woodpulp, 57% paper, and 4% paperboard. Imports to Canada, although relatively insignificant historically, have been growing in recent years due, in large measure, to a phasing out of import tariffs.

PRODUCTION AND OPERATING RATES

Paper. Overall paper production climbed at a 1.5% annualized rate from 1970 to 1980 before picking up the pace to 2.1% during the eighties. Most recently, however, momentum has been in reverse, with production slipping 0.5% in 1989 and 1.6% in 1990. Through the first six months of 1991, the Canadian Pulp & Paper Assn. reported that production tallied 6.861 million tons, compared with 7.045 million tons in the year-ago period—a decline of 2.6%.

Operating rates, which have averaged almost 92% over the last decade, slipped from 94.0% in 1989 to 90.1% in 1990, as the 1.6% decline in production coincided with a 2.7% expansion in capacity. Through the first six months of 1991, CPPA reported that operating rates averaged about 87%, more than seven percentage points lower than in first-half 1990.

Newsprint has long been the mainstay of Canada's paper industry. Over the last 20 years, however, newsprint's share of Canadian production has been declining rapidly, from 83.1% in 1970 to 66.4% in 1990.

An important factor in this trend has been a relatively slow growth rate in newsprint production. From 1970 to 1980, output grew at a compound annual rate of 0.9%, and over the next eight-year span, production edged forward another 1.7% (annualized) despite a major decline in 1982, a

PULP, PAPER, AND BOARD PRODUCTION BY PROVINCE

(000 metric tons)

	Woodpulp	% total	Paper/ paperboard[1]	% total
Quebec	7,217	32%	6,964	42%
British Columbia	6,799	30	2,994	18
Ontario	4,188	18	4,088	25
Other	4,632	20	2,480	15
Total	22,836	100	16,526	100

1. Does not include building board.
Source: Statistics Canada, Canadian Pulp & Paper Assn.

CANADIAN DOLLAR VALUE IN U.S. DOLLARS

(average for year)

Year	C$ = US$	Year	C$ = US$
1991*	0.890	1981	0.834
1990	0.857	1980	0.855
1989	0.845	1979	0.854
1988	0.812	1978	0.877
1987	0.754	1977	0.938
1986	0.720	1976	1.014
1985	0.733	1975	0.982
1984	0.733	1974	1.022
1983	0.812	1973	1.000
1982	0.811	1972	1.000

*Exchange rate as of Oct. 30, 1991.
Sources: *Pulp & Paper Pricebook; Pulp & Paper Week; Wall Street Journal.*

recession year. But the going has been tough since then. In 1989, production slipped 2.0%, and that proved to be only a small taste of what was to come. In 1990, the damage was more severe as production tumbled 5.9% to just over 9 million tons. Through the first six months of 1991, CPPA reported that production tallied 4.605 million tons, compared with 4.733 million tons in the year-ago period, a decline of 2.7% (comparisons in the second half should be more favorable, however, in view of particularly weak production numbers in second-half 1990).

Operating rates, which are a function of production over capacity, largely tracked production levels during the 1980s, bottoming at 81.6% in 1982 before climbing steadily to 98.9% in 1988. The good times have faded in the last few years, however. Indeed, despite machine shutdowns and the conversion of several lines to groundwood specialties, new capacity—from Alberta Newsprint Co. Ltd., Atlantic Newsprint Co., and Canadian Pacific Forest Products

CANADIAN PAPER AND PAPERBOARD PRODUCTION BY MAJOR GRADES, 1980-90

(000 metric tons)

PAPER

Year	Newsprint	Groundwood printing, specialties	Book and writing	Kraft paper	Tissue, special papers	Total paper	Operating rates	
							Newsprint	**Other paper**
1990	9,068	1,775	1,824	497	495	13,659	89.8%	90.7%
1989	9,640	1,658	1,574	525	486	13,883	96.2	89.5
1988	9,840	1,629	1,424	568	488	13,949	98.9	95.3
1987	9,630	1,395	1,297	567	456	13,345	97.7	95.1
1986	9,202	1,306	1,179	541	459	12,687	93.9	94.6
1985	8,890	1,134	1,093	487	447	12,051	91.4	93.2
1984	8,917	1,015	1,027	430	399	11,788	91.8	90.3
1983	8,414	833	960	472	385	11,064	85.1	90.1
1982	8,097	657	830	454	375	10,413	81.6	83.0
1981	8,946	645	787	490	388	11,256	94.3	85.2
1980	8,625	614	895	533	377	11,044	94.5	91.6
1970	7,910	378	544	415	269	9,516	n.a.	n.a.
Growth rates								
1989-90	-5.9%	7.1%	15.9%	-5.3%	1.9%	-1.6%		
1981-90	0.5	11.2	7.4	-0.7	2.8	2.1		
1971-80	0.9	5.0	5.1	2.5	3.4	1.5		

PAPERBOARD

Year	Containerboard			Boxboard	Total Paperboard	Total paper/ paperboard	Operating rates	
	Total	**Linerboard**	**Corrugating medium**				**Paperboard**	**Total paper/ paperboard**
1990	2,045	1,304	741	761	2,806	16,465	92.8%	90.5%
1989	1,944	1,218	726	755	2,699	16,582	94.7	94.1
1988	1,981	1,267	714	723	2,704	16,653	96.4	97.6
1987	1,953	1,255	698	742	2,695	16,040	98.4	97.2
1986	1,847	1,199	648	726	2,573	15,260	96.2	94.4
1985	1,677	1,126	551	697	2,374	14,425	89.0	91.4
1984	1,695	1,087	608	745	2,440	14,228	92.2	91.6
1983	1,575	1,021	554	711	2,286	13,350	89.3	86.8
1982	1,364	891	473	618	1,982	12,395	77.5	81.2
1981	1,646	1,088	558	701	2,347	13,603	87.7	91.4
1980	1,671	1,175	496	673	2,344	13,388	89.3	93.0
1970	1,041	710	331	523	1,564	11,080	n.a.	n.a.
Growth rates								
1989-90	5.2%	7.1%	2.1%	0.8%	4.0%	-0.7%		
1981-90	2.0	1.0	4.1	1.2	1.8	2.1		
1971-80	4.8	5.2	4.1	2.6	4.1	1.9		

n.a. = Not available.
Source: Canadian Pulp & Paper Assn.

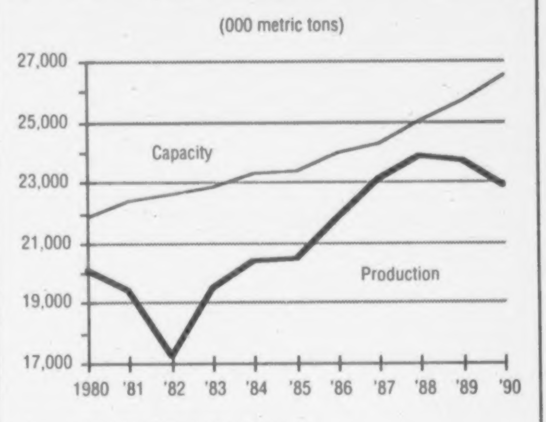
Ltd.—caused capacity to edge forward in 1989 and 1990. Consequently, the drop in operating rates, to 96.2% in 1989 and 89.8% in 1990, was even more severe than that for production. Through the first six months of 1991, CPPA reported that operating rates averaged 89%, compared with 95% in first-half 1990.

Newsprint's companion grades—uncoated groundwood specialties or mechanical printing papers—have increased in output every year since the early seventies, with old newsprint machines being converted to produce the more profitable groundwood grades making up most of the new tonnage. In 1975, groundwood specialties was a fairly insignificant grade, with reported production tallying just 286,000 tons. Over the next decade, however, output quadrupled to 1.134 million tons. Production then jumped another 15.2% from 1985 to 1986, 6.8% from 1986 to 1987, 16.8% from 1987 to 1988, and 1.8% from 1988 to 1989. In 1990, the pace picked up again with production gaining 7.1% for the year.

The book and writing papers segment has also been a growing sector as Canadian companies attempt to shift a greater share of their product mix from commodity (especially market pulp and newsprint) to value-added grades. Output doubled from 458,000 tons in 1975 to 914,000 tons in 1979 before slipping back two consecutive years and bottoming at 787,000 tons in 1981. Since then, new capacity from Domtar Inc., Canadian Pacific Forest Products, and Weyerhaeuser Canada Ltd. has helped this sector regain its forward momentum, with production growing at an annualized rate of 9.8% from 1982 through 1990.

Production of tissue (and special papers such as greaseproof and glassine grades) has posted a moderate 3.1% growth rate over the last two decades. And from 1988-90, production increased an average of only 0.7% a year. Looking forward, however, a wave of new capacity is laying the groundwork for an acceleration in production growth. Four new machines have come online since late 1989: Irving Pulp & Paper Ltd. (60,000 tpy), Atlantic Packaging Products Ltd. (30,000 tpy), Cascades Inc. (40,000 tpy), and Perkins Papers Ltd. (30,000 tpy). Moreover, Consumers Paper & Supply Corp. has slated a new 30,000-tpy machine for

TOTAL PULP PRODUCTION vs CAPACITY



Source: Canadian Pulp & Paper Assn.

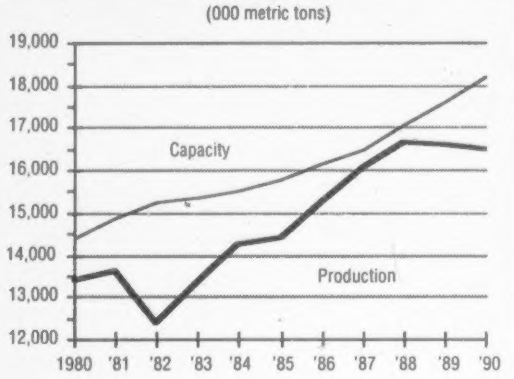
CANADIAN WOODPULP PRODUCTION BY MAJOR GRADES

(000 metric tons)

Year	Total sulfite	Bleached sulfate hardwood	Bleached sulfate softwood	Total sulfate	Semi-chemical	Total chemical	Total mechanical	Total woodpulp	Operating rate	Total capacity
1990	1,451	1,597	6,340	8,800	465	12,299	10,537	22,836	86.1%	26,525
1989	1,627	1,577	6,868	9,500	432	13,194	10,514	23,708	92.1	25,736
1988	1,739	1,409	6,974	9,483	430	13,389	10,429	23,818	95.2	25,021
1987	1,750	1,324	6,887	9,380	440	13,294	9,829	23,123	95.3	24,260
1986	1,676	1,299	6,324	8,811	406	12,536	9,262	21,798	90.7	24,029
1985	1,598	1,174	5,873	8,217	330	11,758	8,723	20,481	87.4	23,423
1984	1,771	1,214	5,568	7,847	410	11,727	8,690	20,417	87.6	23,305
1983	1,657	1,050	5,693	7,762	382	11,511	7,945	19,456	85.0	22,889
1982	1,726	817	5,098	6,831	319	10,342	6,895	17,237	76.2	22,618
1981	2,249	812	5,449	7,318	382	11,732	7,659	19,391	86.5	22,424
1980	2,168	832	5,922	7,936	402	12,525	7,529	20,054	91.7	21,864
1970	2,554	n.a.	n.a.	7,104	295	9,381	7,227	16,608	n.a.	
Growth rates										
1989-90	-10.8%	1.3%	-7.7%	-7.4%	7.6%	-6.8%	0.2%	-3.7%		
1981-90	-3.9	6.7	0.7	1.0	1.5	-0.2	3.4	1.3		
1971-80	-1.6	n.a.	n.a.	1.1	3.1	2.9	0.4	1.9		

Source: 1970, Statistics Canada; 1980-90, Canadian Pulp & Paper Assn.

startup in 1992. It is uncertain, however, how much of this new capacity will be translated into production, since domestic demand is likely to absorb only a share of the new tonnage and penetration of export markets may prove a tall order.


TOTAL PAPER AND PAPERBOARD PRODUCTION VS CAPACITY

(000 metric tons)

Source: Canadian Pulp & Paper Assn.

Indeed, tissue capacity is growing at a respectable rate south of the border, and tariffs, which historically have been higher on Canadian than U.S. imports, are in the process of being eliminated. Consequently, the Canadians may struggle to maintain net exporter status, let alone exploit new outlets. Concerns of this type might well have been at work when Canadian Pacific Forest Products relinquished its roughly 13% share of the Canadian tissue market through the sale of Facelle Co. to Procter & Gamble Co. in August 1991.

Kraft paper production, in the meantime, has actually declined over the last decade, including a sharp 14.3% drop in the last two years (about 40% of the decline since 1988 is attributable to operating problems at Eurocan Pulp & Paper Co.'s Kitimat, B.C., mill). Looking forward, CPPA projects capacity will hold flat from 1991 through 1993.

Paperboard. Paperboard is a relatively small industry in Canada, with production tonnage totaling 2.8 million tons in 1990. Paperboard production climbed at a 4.1% annualized rate from 1970 to 1980, although the pace slackened in the eighties to 1.8%. Through the first six months of 1991, CPPA reported that production was 1.463 million tons, compared with 1.396 million tons in the year-ago period, a pickup of 4.8% (over half of this gain, it should be noted, is attributable to increased producer inventories).

Operating rates, which have averaged 91.2% over the last ten years, slipped from 94.7% in 1989 to 92.8% in 1990, as the 4.0% rise in production only partially offset a 6.0% increase in capacity. Through the first six months of 1991, CPPA reports that operating rates averaged about 92%, vs 93% in first-half 1990.

Linerboard makes up the largest component of Canada's paperboard industry, accounting for 46.5% of production in 1990. Linerboard production dipped 3.9% in 1989 before bouncing back with a 7.1% increase in 1990. The majority of the fluctuation in linerboard production was again attributable to Eurocan's Kitimat mill.

The balance of paperboard production is split between corrugating medium (26.4% in 1990) and boxboard (27.1% in 1990).

Looking forward, with no major containerboard capacity additions expected through 1993, the biggest changes will probably revolve around who owns the existing facilities. CP Forest's and Paperboard Industries Corp.'s con-

CANADIAN NEWSPRINT EXPORTS BY DESTINATION, 1980-90

(000 metric tons)

Year	U.S.	U.K.	Latin America	Western Europe	Asia	Other countries	Total
1990	6,423	369	375	304	398	130	7,999
1989	6,751	466	350	278	422	199	8,466
1988	6,989	353	393	229	434	144	8,542
1987	7,072	327	420	214	388	139	8,560
1986	6,672	293	416	175	354	208	8,118
1985	6,593	274	327	74	455	160	7,883
1984	6,500	376	357	143	355	132	7,863
1983	5,969	502	428	163	245	98	7,405
1982	5,584	541	471	171	240	101	7,108
1981	6,062	541	625	189	356	98	7,871
1980	6,118	442	518	181	267	116	7,642
1970	5,591	405	580	146	313	212	7,247
Growth rates							
1989-90	-4.9%	-20.8%	7.1%	9.4%	-5.7%	-34.7%	-5.5%
1981-90	0.5	-1.8	-3.2	5.3	4.1	1.1	0.5
1971-80	0.9	0.9	-1.1	2.2	-1.6	-5.9	0.5
% total exports							
1990	80%	5%	5%	4%	5%	2%	100%
1985	84	3	4	1	6	2	100
1980	80	6	7	2	3	2	100
1970	77	6	8	2	4	3	100

Source: Canadian Pulp & Paper Assn.

tainerboard operations, which combined account for an estimated 16% of the market, are for sale. And Canada's largest producer, Domtar, with a 16% or so share of the market, might eventually seek buyers for its containerboard operations as it strives to focus more profitability on fewer products. Boxboard production, on the other hand, should rise, reflecting increased production from Tembec Inc.'s 140,000-tpy solid bleached board machine, which came online late in 1990.

Pulp. After six years of steady growth, woodpulp production stuttered in 1989 and then fell 3.7% to 22.8 million tons in 1990 due to weak demand (caused by a reduction in paper and board production) and heated competition from foreign pulp producers. The sharpest percentage decline was for sulfite pulps, whose use has been trending lower for a number of decades partly due to environmental considerations. But the mainstay, bleached sulfate softwood pulp, which accounts for about 55% of all chemical pulp produced in Canada, also declined sharply (7.7%).

Through the first six months of 1991, CPPA reported that woodpulp production has stabilized, tallying 11.762 million tons, compared with 11.742 million tons in the year-ago period. The story for operating rates has been similar. After peaking at more than 95% in the late eighties, operating rates slipped over nine percentage points in two years. Given flat production and increased capacity, operating rates continued to slide through first-half 1991.

(Market pulp, the subset of woodpulp consisting of pulp sold in open competition with that of other manufacturers, witnessed a sizable 12.1% decline in production during 1990 to 6.234 million tons. Through first-half 1991, however, CPPA reported a partial recovery, with production at 3.409 million tons, up 4.8% over the year-ago period. Operating rates for market pulp, meanwhile, after averaging about 98% in 1989, sunk to 84% in 1990 before pulling back to 87% in first-half 1991.)

Although a fair measure of weakness in Canada's pulp industry is attributable to cyclical economic forces, there are longer-term concerns. In particular, Canadian (and Nordic) producers are fighting an uphill battle due to higher production costs than their rivals in the U.S. and the fast-growing pulp industries in Brazil and Chile. Also, the growing use of recycled furnish is impacting the pulp industry.

One product that has proven to be particularly vulnerable has been bleached chemi-thermomechanical pulp (BCTMP). With much traditional pulp available at low prices, buyers have hesitated to incorporate BCTMP into their products. The lack of demand caused two major BCTMP mills, in Port Cartier and Matane, Que., to shut down in 1991.

EXPORTS

Canada, one of the world's largest exporters of pulp and paper products, had overseas shipments totaling 19.453 million tons in 1990, down 2.6% from the record levels achieved the year before. Through the first six months of 1991, overseas shipments were relatively flat (9.937 million tons) as exports to Europe (up 15% to 1.808 million tons) and other markets (up 25% to 1.933 million tons) offset a decline in exports to the U.S. (down 8% to 6.196 million tons).

Canada is the world's leading exporter of newsprint, accounting for 55% to 60% of all international sales volume in 1990. Canada exported 8 million tons of newsprint in 1990, 80% of which was bound for the U.S. Other important markets include Western Europe and Asia, especially Japan.

Printing and writing papers make up the bulk of Canada's remaining paper exports. About 1.3 million tons of groundwood specialties were exported in 1990, a decline of 18%. Book and writing papers, on the other hand, experienced a dramatic 43% increase in tonnage exported as considerable new capacity (for example, from Domtar's Windsor, Que., mill) was directed to the U.S., where import tariffs are gradually being reduced pursuant to the Canada-U.S. Free Trade Agreement. In the meantime, paperboard, for which tariffs are also being phased out, enjoyed a

CANADIAN WOODPULP EXPORTS BY DESTINATION, 1979-90

(000 metric tons)

Year	U.S.	U.K.	Other Western Europe	Latin America	Japan	Other countries	Total
1990	3,617	319	1,871	145	943	792	7,686
1989	3,687	384	2,013	131	1,303	831	8,348
1988	3,784	398	1,897	159	1,182	976	8,396
1987	3,649	394	1,809	205	1,129	1,055	8,241
1986	3,530	433	1,745	189	911	875	7,683
1985	3,408	321	1,483	155	789	852	7,008
1984	3,426	385	1,391	146	708	643	6,699
1983	3,289	272	1,594	101	744	795	6,795
1982	2,857	269	1,431	65	682	520	5,824
1981	3,250	326	1,667	96	692	568	6,599
1980	3,433	377	1,794	142	885	564	7,195
1979	3,577	408	1,606	86	689	416	6,782
Growth rates							
1989-90	-1.9	-16.9	-7.1	10.7	-27.6	-4.7	-7.9
1981-90	0.5	-1.7	0.4	0.2	0.6	3.5	0.7

Source: Canadian Pulp & Paper Assn.

healthy 29.1% increase as exports of boxboard and linerboard climbed, thanks in part to new capacity from Tembec's new Temiscaming, Que., mill and Eurocan's expanded Kitimat facility.

Canada is the world's largest exporter of woodpulp, accounting for about one-third by weight of worldwide shipments. Again, the most important market for Canadian producers is the U.S., which accounted for 47% of Canada's 1990 exports.

Over the last ten years, exports have climbed at a 0.7% compound annual rate, with the fastest growth (until a sharp reversal in 1990) occurring in exports to Japan. But performance was weak across the board in 1989 and 1990. After having peaked in 1988 at 8.396 million tons, exports dipped slightly in 1989. Then, in 1990, CPPA reported that exports sunk 7.9% to 7.686 million tons. The news improved in first-half 1991, however, as total exports for the six months were up 9.5% compared with the year-ago period, despite continued decline (-3.3%) in tonnage exported to the U.S.

CANANDIAN PAPER AND PAPERBOARD EXPORTS BY MAJOR GRADES, 1980-90

(000 metric tons)

PAPER

Year	Newsprint	Groundwood printing	Book and writing	Kraft paper	Tissue and sanitary	Other papers	Total papers
1990	7,999	1,298	667	395	85	41	10,485
1989	8,466	1,582	467	339	62	35	10,951
1988	8,542	1,533	291	350	65	49	10,830
1987	8,560	901	287	300	64	66	10,178
1986	8,118	606	244	265	52	48	9,333
1985	7,883	514	257	211	53	30	8,948
1984	7,863	652	206	179	41	28	8,969
1983	7,405	522	211	221	32	24	8,415
1982	7,108	417	254	187	29	22	8,017
1981	7,871	290	284	207	29	28	8,709
1980	7,642	277	393	233	27	23	8,595
1970	7,247	139	171	102	16	9	7,684
Growth rates							
1989-90	-5.5%	-18.0%	42.8%	16.5%	37.1%	17.1%	-4.3%
1981-90	0.5	16.7	5.4	5.4	12.2	6.0	2.0
1971-80	0.5	7.1	8.7	8.6	5.4	9.8	1.1

PAPERBOARD

	Containerboard					
Year	Total	Linerboard	Medium	Boxboard	Total paperboard	Total paper/board
1990	542	359	183	229	771	11,256
1989	497	241	256	100	597	11,548
1988	563	301	262	66	629	11,459
1987	549	282	267	75	624	10,802
1986	551	320	231	64	615	9,948
1985	428	291	137	63	491	9,439
1984	444	246	198	86	530	9,499
1983	460	281	179	57	517	8,932
1982	336	193	143	28	364	8,381
1981	422	268	154	34	456	9,165
1980	510	328	182	36	546	9,141
Growth rates						
1989-90	9.1%	49.0%	-28.5%	129.0%	29.1%	-2.5%
1981-90	0.6	0.9	0.1	20.3	3.5	2.1

Source: Canadian Pulp & Paper Assn.

ANTICIPATED SCHEDULE OF TARIFF REDUCTIONS FOR SELECTED GRADES, 1988-93

	1993	1992	1991	1990	1989	1988
Canadian tariffs on imports from U.S.						
Printing papers						
cut to size	0.0%	1.6%	3.2%	4.8%	6.4%	8.0%
not cut to size	0.0	1.3	2.6	3.9	5.2	6.5
Writing papers	0.0	1.3	2.6	3.9	5.2	6.5
Coated groundwood	0.0	0.5	1.0	1.5	2.0	2.5
Recycled boxboard	0.0	1.8	3.6	5.4	7.2	9.2
Linerboard	0.0	1.3	2.6	3.9	5.2	6.5
Solid bleached board	0.0	1.3	2.6	3.9	5.2	6.5
Corrugating medium	0.0	0.8	1.6	2.4	3.2	4.0
Unbleached kraft paper	0.0	0.8	1.6	2.4	3.2	4.0
Bleached wrapping papers	0.0	1.8	3.6	5.4	7.2	9.2
Sanitary papers (rolls)	0.0	1.3	2.6	3.9	5.2	6.5
cut to size	0.0	2.0	4.0	6.0	8.0	10.2
Folding cartons	0.0	2.0	4.0	6.0	8.0	10.2
Corrugated boxes	0.0	1.8	3.6	5.4	7.2	9.2
Paper bags	0.0	1.8	3.6	5.4	7.2	9.2
U.S. tariffs on imports from Canada						
Bristols, drawing	0.0%	0.4%	0.7%	1.0%	1.3%	1.6%
Carbonizing paper						
15 g/m² and under	0.0	0.5	1.0	1.5	2.0	2.6
over 15 g/m²	0.0	0.4	0.8	1.2	1.6	2.0
Cover, writing	0.0	0.4	0.9	1.4	1.9	2.4
India, bible papers						
less than 40 g/m²	0.0	0.4	0.7	1.0	1.3	1.6
40 to 150 g/m²	0.0	0.2	0.6	1.0	1.4	1.8
Coated printing papers						
woodfree	0.0	0.5	1.0	1.5	2.0	2.5
groundwood, LWC	0.0	0.5	1.0	1.5	2.0	2.5
Sulfite wrapping	0.0	0.4	0.9	1.4	1.9	2.4
Corrugating medium	0.0	0.8	1.6	2.4	3.2	4.0
Packaged sanitary	0.0	1.3	2.3	3.3	4.3	5.3

Source: Canadian Pulp & Paper Assn.

CANADIAN WOODPULP SHIPMENTS[1] AND INVENTORIES[2] BY MAJOR GRADES, 1979-90

(000 metric tons)

Year	Bleached sulfite	Unbleached sulfite	Bleached softwood sulfate	Bleached hardwood sulfate	Semi-bleached sulfate	Unbleached sulfate	Total chemical paper-grade	Mechanical	Dissolving & special alpha	Total woodpulp
1990	373	40	5,371	936	319	134	7,173	1,045	207	8,425
1989	377	37	6,050	966	410	100	7,940	1,023	268	9,231
1988	421	47	6,377	926	431	104	8,306	801	268	9,375
1987	437	48	6,317	911	474	119	8,306	676	243	9,226
1986	412	51	5,860	846	529	133	7,831	469	239	8,539
1985	329	52	5,357	819	506	158	7,221	384	216	7,821
1984	330	60	5,021	877	436	161	6,885	464	221	7,570
1983	296	61	5,332	745	418	191	7,043	317	209	7,569
1982	275	76	4,515	537	356	181	5,940	273	227	6,440
1981	387	105	4,979	602	485	226	6,784	284	271	7,339
1980	392	122	5,381	592	579	232	7,298	322	310	7,930
1979	406	111	5,096	558	531	264	6,966	109	371	7,446
Growth rates										
1989-90	-1.1	8.1	-11.2	-3.4	-22.2	34	-9.7	2.2	-22.8	-8.7
1981-90	-0.5	-10.6	-0.1	4.7	-5.8	-5.3	-0.2	12.5	-4.0	1.2

1. Excluding pulp sent to integrated and affiliated mills inside Canada.
2. End of year.
Source: Canadian Pulp & Paper Assn.

Canada:

PRICES

Most of Canada's paper and paperboard production and nearly all of its market pulp production is bound for export markets, where it is customarily priced in U.S. dollars. Consequently, in determining local prices for Canadian producers (particularly newsprint and market pulp) supply and demand share center stage with exchange rates.

The Canadian dollar dropped from approximate parity with the U.S. dollar in 1977 to below US75¢ in 1985. This 25% decline was a boon to the Canadian producers, who pay the bulk of their expenses in Canadian dollars but were raking in the increasingly valuable U.S. greenback. Indeed, favorable exchange rate fluctuations may well have helped prolong the life of a number of mills during the recessionary early eighties, especially in British Columbia. But starting in 1986, this process shifted into reverse, and by mid-1991, the Canadian dollar had climbed back to 86¢. This meant that during the heyday of the late eighties, Canadian producers gained less from price increases for export grades than did their counterparts in the U.S. Moreover, the continued strength in the Canadian dollar has added hardship in recent years, during which the supply/demand balance has been pushing pulp, paper, and paperboard prices lower in U.S. dollars. And with the large amounts of new capacity likely to keep a lid on pricing for market pulp and newsprint for a while to come, the Canadians look to have their work cut out for them in the years ahead.

THE EXPORT GRADES: MARKET PULP AND NEWSPRINT

The dominant market pulp grade in Canada is northern bleached softwood kraft (NBSK), which accounts for about 65% of shipments (mechanical pulps and bleached hardwood pulps each account for another 10% to 15%).

NBSK is of higher quality but costs more to produce than southern bleached softwood kraft (SBSK). It typically sells at a premium to SBSK, more than $150/ton in second-quarter 1990 but closer to $50/ton in September 1991 (Canadian hardwood pulps, which have greater opacity but lesser strength properties, meanwhile were selling about $60/ton lower than NBSK in September 1991).

Pricing for NBSK and other paper-grade pulps has certainly merited being called volatile over the last decade. In second-quarter 1980, the price of Canadian NBSK pulp exported to Europe hit a previous all-time high of US$545/metric ton, c.i.f. northern Europe. In first-quarter 1982, producers attempted to raise the benchmark price by $35. Not only did they fail, but the soon-evident worldwide recession drove pricing backward. By August 1982, list quotes were down to the late-1979 level of US$465/ton—only $30 above the previous peak achieved in early 1975. By the first quarter of 1983, they had fallen further to just US$410, with spot-market quotes below that readily available.

A shutdown of most British Columbian mills caused by a labor dispute firmed up markets in early 1984, sparking a price recovery to US$540/ton for NBSK in Europe. But later in the year, overcapacity and a strong U.S. dollar combined to knock market pulp prices down again. By the end of 1984, a ton of NBSK sold in northern Europe for around US$470 to US$480, and prices plummeted below US$400 in early 1985. Over the 1980-85 period, however, Canadian producers were gaining a measure of protection from the steady 15% devaluation in the local currency relative to the U.S. dollar from $0.855 to %0.733. Then in late 1985, the tide turned as pulp markets began to tighten and a declining U.S. dollar (against other major worldwide currencies) reversed the cost advantage of Scandinavian competitors, making price increases (denominated in dollars) easier for overseas customers to absorb.

Producers pushed through four consecutive quarterly price hikes in 1986, bringing NBSK back to US$520/ton. More increases followed, and by first-quarter 1989, NBSK was selling at US$800/ton ($810/ton in Europe). The advance continued hesitantly for another year, and by the end of first-quarter 1990, NBSK pricing stood at US$830/ton, with some discounting. In sum, NBSK prices had more than doubled, in U.S. dollars, in three and a half years. Due to a roughly 17% increase in local currency relative to the U.S. dollar, Canadian pulp exporters enjoyed a healthy, but less spectacular, increase.

NBSK prices held relatively firm through mid-1990 before beginning a descent in second-quarter 1990 that has been almost as rapid as the rise in the late eighties. Indeed, by third-quarter 1991, NBSK was selling at an estimated US$500/ton.

NEWSPRINT

In evaluating newsprint prices for Canadian producers, attention is turned to delivered prices in the U.S. since about 80% of Canada's newsprint output is sold in the U.S. market. Newsprint prices had a stronger showing than market pulp during the early 1980s.

From 1981 to 1985, export prices for 30-lb newsprint delivered in the eastern U.S. climbed an average of 6.7%/year, to US$535/ton, with only one year of decline in 1982. This performance followed a steady rise in the late 1970s, when prices had climbed an average of 11.9%/year. In 1985, however, momentum was checked as producers launched several attempts to raise prices, all of which were aborted due to soft demand and increased imports of cheap offshore paper. It was not until October of the following year that gradually improving demand enabled producers to force a price hike, bringing the list quote to US$570/ton. Yet it was initially something of a phantom increase as most tonnage was still sold in the US$530 to US$550 range until early 1987, by which time the increase had been fully implemented. Markets remained strong in 1987, and producers increased list prices on July 1 and again on Jan. 1, 1988.

The July 1987 increase brought the list price to US$610/ton in the eastern U.S., and the January 1988 hike boosted it to US$650/ton. But by this time, list and transaction prices reflected two very different worlds; in terms of real money, newsprint was selling in the range of US$570 to US$610/ton through most of 1988. Moreover, by December 1988, transaction prices had begun to erode further. And by June 1989, they had plunged to US$575/ton in the eastern U.S. and US$560/ton in the western U.S. In first-quarter 1990, although list prices held fast at US$650/ton in the East, transaction pricing on newsprint had slipped closer to US$535/ton (US$540/ton on the West Coast). A price increase was implemented in June, bringing list in the East to US$685/ton. Transaction prices continued to run about US$120 off list, or at US$565/ton. The next push came at the turn of 1991, when producers raised the list price per ton by US$35 to US$720 in the East and to US$665 in the West. In response, transaction prices edged up US$15 to US$20 to an estimated US$582/ton in the East and US$588/ton on the West Coast. By April, however, the momentum was clearly with the buyers as list and transaction prices headed swiftly back in the other direction. As of August 1991, the high-end transaction prices on newsprint were estimated at US$520/ton in the East and US$525/ton in the West.

The effect of exchange rates during this decade of tumultuous pricing has been significant. As the Canadian dollar moved from near parity in 1975 to US733¢ in 1985, Canadian producers benefitted immensely. Indeed, whereas newsprint pricing had risen 84% in U.S. dollars, the Canadians had reaped a whopping 147% increase in local currency. But exchange rates reversed course in 1986, and although from 1985 to 1990 newsprint witnessed a 1% increase in pricing, the Canadians suffered a 14% decline in local currency.

DOMESTIC PRICING

Production of fine papers and containerboard is significantly less than that of newsprint and market pulp, and the bulk of that produced is sold in the domestic market (although it is worth noting that fine papers has been a rapidly growing grade in Canada, and much of the new capacity has been directed to export markets so that in 1990 about 63% of production was consumed inside Canada vs 80% in 1988).

From 1971 to 1980, both fine papers and containerboard enjoyed steady gains in pricing, averaging compound rates of 9.1% and 10.1%/year, respectively. These rates of increase, although none too shabby, noticeably lagged the rate of increase for Canada's major export grades—newsprint and market pulp. During the eighties, on the other hand, the domestic-market grades enjoyed better relative price performance than their exported counterparts.

From 1981 to 1990, the price index for fine papers, as reported by Statistics Canada, increased every year at a compound annual rate of 5.5%. This upward streak, however, looks to be broken in 1991. Containerboard prices, meanwhile, averaged a 5.7% annual increase in prices during the 1981-90 period. This includes a particularly dynamic rate of growth from 1986 through 1988, before a leveling off in 1989 and a reversal in momentum in 1990.

Although Canadian prices generally track U.S. prices (adjusted for exchange rate fluctuations), the correlation has been less than exact, with prices generally running higher north of the border. For instance, when U.S. prices for printing/writing papers were near their cyclical peak in early 1981 and coated No. 3 printing paper (60-lb rolls) went for US$897/short ton in the U.S., Canadian buyers, by one estimate, paid the equivalent of US$1,070. Also at that time, Canadian consumers paid an estimated US$30/short ton more for their 50-lb multiwall kraft sack paper than the US$405 price in the U.S.

Two key factors are behind this apparent challenge to efficient market pricing. First, domestic Canadian producers were protected in the past by relatively high tariffs (approximately 15%) on a range of grades (for a closer look at tariffs by grade, please refer to the chapter, Canada: Production, Exports, and Imports). However, a staged reduction from 1980 to 1987 reduced tariff rates by more than half in most cases. Then in 1987, the U.S. and Canada negotiated a trade agreement to remove the remaining barriers and to open both markets to free competition. This was expected to benefit the U.S. paper industry by adding an estimated US$85.9 million in export dollar volume by 1999, according to the New York State Dept. of Economic Development. Canadian pulp and paper mills, however, are not expected to reap much of an advantage. In fact, increased competition from more efficient U.S. producers threatens to undermine profitability for domestic producers of grades such as containerboard and tissue. U.S. companies have often appeared to believe it not worth their while to pursue aggressively the relatively small Canadian market. But this could well be changing as evidenced by the fact that in 1990, Canada imported more than 1 million metric tons of paper and paperboard products (including 521,000 tons of printing and writing papers, 243,000 tons of boxboard, and 145,000 tons of kraft papers), about double the tonnage imported just five years earlier.

PRICE INDEXES FOR SELECTED COMMODITIES

(1981 = 100)

Year	Fine paper—writing and reproduction (domestic)	Containerboard (domestic)	Bleached sulfite pulp (export)	Bleached sulfate pulp (export)	Unbleached sulfate pulp (export)	Newsprint (export)
1990	161.6	164.4	139.3	149.5	149.5	128.7
1989	157.6	164.7	152.9	158.8	158.8	129.4
1988	150.2	162.2	138.3	143.0	143.0	137.5
1987	143.6	148.9	119.2	122.4	122.5	129.2
1986	136.4	137.2	95.6	98.2	98.1	123.0
1985	129.9	135.3	83.7	87.3	86.9	119.7
1984	126.5	128.9	97.1	102.3	102.2	109.6
1983	116.4	119.3	79.7	80.9	80.6	98.7
1982	112.2	112.1	92.4	93.6	93.5	104.7
1981	100.0	100.0	100.0	100.0	100.0	100.0
1980*	219.0	238.5	342.1	341.0	379.0	300.2
1979*	197.7	200.2	279.4	278.9	303.0	268.0
1978*	173.6	171.7	210.2	213.1	216.0	236.4
1977*	165.0	166.7	220.8	233.1	221.0	210.4
1976*	161.6	162.5	218.8	230.6	226.9	177.6
Average annual change						
1981-90	5.5%	5.7%	3.8%	4.6%	4.6%	2.8%
1971-80	9.1	10.1	14.6	14.6	16.0	13.0

*Base year for 1976-80 data is 1971.
Source: Statistics Canada.

Canada:

PROFITABILITY

The Canadian pulp and paper industry had an unpleasant 1990 due to especially unfavorable economics for newsprint and market pulp, the mainstay grades of the industry. A *Pulp & Paper* magazine survey of 17 Canadian companies showed adjusted 1990 sales of C$20.0 billion, down 8% from 1989. The damage was far more severe at the bottom line, however, as these same 17 companies racked up a discouraging $248.5-million deficit, vs a $1.18-billion profit in 1989.

The depth of the industry's malaise resulted from a confluence of factors, the main culprit being pricing for newsprint and market pulp. The downward trend in prices for both pulp and newsprint can be tied to the addition of significant capacity complicated by anemic demand due to weak economies in North America. Newsprint prices zigzagged through the year but fell rapidly in the second half so that for all of 1990, average selling prices on the East Coast were about 6% lower in U.S. dollar terms. The direction in market pulp pricing was more distinct. Entering the year at US$830, northern bleached softwood kraft (NBSK) pulp prices exported to the U.S. had dropped about 10%, to US$750/ton, by year end.

To make matters worse, the Canadians continued to bend under the strain of an ever-strengthening local currency. Compared with the U.S. dollar, Canadian currency was about 1.4% stronger in 1990 than the year earlier, averaging approximately US$0.857, compared with US$0.845 in 1989. These exchange rate fluctuations have had a major impact on Canada's bottom line. According to Statistics Canada, exports totaled roughly $15.2 billion worth of pulp and paper products in 1990 (of which about 39% was newsprint and 40% pulp), so exchange rate fluctuations in 1990 (not adjusted for demand sensitivity) impacted pretax earnings by more than $200 million. Other factors hurting earnings in 1990 were high stumpage rates in British Columbia and labor strikes at newsprint mills in Quebec, Ontario, and New Brunswick.

The prognosis at the end of 1990 was not good. Indeed, the 17 companies included in the *Pulp & Paper* survey had actually tallied a profit of about $200 million in first-half 1990 before piling up net losses of almost $450 million (about one-third of which was related to net nonrecurring charges) in second-half 1990.

Results through the first six months of 1991 have been disastrous. *Pulp & Paper*'s survey of 17 Canadian companies showed sales down 12% and net losses reaching $438.7 million with less than 10% of this total related to nonrecurring items. The most significant reason behind the earnings fall has been the accelerating descent in pulp prices; by September 1991, NBSK was changing hands at less than $500/ton, 40% below prices about 18 months earlier. And with mid-1991 worldwide inventories of chemical paper-grade market pulp at their highest level since March 1985 and Canadian inventories at their highest since November 1977, the outlook is bleak for the remainder of the year.

COMPANY ROUNDUP

Abitibi-Price Inc. reported a $45-million net loss in 1990, including $35 million in restructuring charges. Major damage was caused by an evaporation of operating profits at the company's newsprint and groundwood paper businesses ($3 million in 1990 vs $102 million in 1989 and $251 million in 1988). Exacerbating Abitibi's woes, the company's coating papers businesses posted operating losses of $26 million in 1990, vs a loss of $8 million in 1989. Through first-half 1991, Abitibi's bottom line had made little real progress as newsprint and groundwood papers remained in the doldrums and losses at the coated papers operations continued to mount. Canadian Pacific Forest Products Ltd. posted a $9-million net loss in 1990, vs $220 million in profits for 1989 and $323 million in 1988. The sharp earnings decline is of no great surprise given CP Forest's heavy reliance on commodity products, especially newsprint and market pulp. After having posted record operating profits of $204 million in 1988, CP Forest's newsprint segment's contribution dwindled to $22 million in 1989 and then went $44 million in the red in 1990 due to weak pricing and strikes at three of the company's eastern mills. The pulp segment, meanwhile, peaked in 1989, with operating profits tallying $323 million before rapidly descending to $129 million in 1990. As pulp and paper prices continued to slide in first-half 1991, so did CP Forest's bottom-line performance. For the first six months, the company reported a $106-million deficit.

CP Forest's monstrous loss catapulted the firm into the undesirable position of Canada's most unprofitable paper company. In the meantime, the holder of this title in 1990, Domtar Inc., stayed in the running. In 1990, Domtar's pulp, paper, and building products operations came up $96 million short, and the company booked $198 million in restructuring costs and write-offs net of nonrecurring gains. At mid-year 1991, Domtar claimed that the restructuring plan was expected to reduce the cost base for full-year 1991 by a minimum of $125 million. Even so, continued operating losses plus high interest expense led to a sizable $65-million deficit for first-half 1991.

Fletcher Challenge Canada Ltd. and MacMillan Bloedel Ltd. were the most profitable paper companies in Canada during 1990. FCC's operations, which include coated papers (22% of 1990 consolidated sales), newsprint (21%), market pulp (19%), and wood products (38%), pulled in $55 million, helped by a $21-million gain related to the sale of an oriented strand board plant in Minnesota. MacMillan Bloedel, meanwhile, earned $51 million as strong results at KNP, a major Dutch papermaker in which MacMillan has a 30.6% equity stake, offset collapsing profitability at its pulp, paper, containerboard, and building materials operations. Bottom lines are turning red in 1991, however, as FCC and MacMillan reported first-half losses of $27.2 million and $11.3 million, respectively.

During 1990, Noranda Forest Inc., despite a 50% equity stake in the profitable MacMillan Bloedel, posted a $95-million deficit as the company was burdened by a mammoth $238-million interest expense. And 1991 is providing no solace, as the company posted an $80-million loss for the first six months. Commenting on the results, Noranda

CANADIAN PULP AND PAPER COMPANY SALES AND EARNINGS

(million C$)

	Full-year 1990				First-half 1991			
	Sales	% change vs 1989	Net income[1]	% change vs 1989[2]	Sales	% change vs 1990	Net income[3]	% change vs 1990[4]
Abitibi-Price	$3,088	-5%	$-44.6	-182%	$1,456	-8%	$-11.2	n.m.
CP Forest	2,313	-20	-9.4	-104	1,059	-16	-106.5	n.m.
Canfor	884	-4	3.8	-96	428	-10	-26.4	-161%
Cascades	818	20	20.1	-33	422	7	3.4	-61
Crestbrook	220	-16	10.8	-66	80	-33	-5.8	-171
Doman	583	20	5.4	-83	265	-14	-20.5	-381
Domtar	2,314	-8	-294.0	-991	918	-25	-65.0	n.m.
Donohue	611	-5	29.1	-34	257	-19	-5.1	-132
Fletcher Challenge Canada	1,160	-21	54.9	-43	536	-8	-27.2	-152
MacMillan Bloedel[6]	3,003	-8	50.8	-79	1,406	-12	-7.5	-113
Noranda Forest[6]	4,555	-7	-95.0	-150	2,115	-13	-80.0	n.m.
Repap	1,102	-10	3.1	-97	558	-7	-52.1	-777
Rolland	402	-8	0.9	n.m.	161	-25	-1.0	n.m.
Scott Paper Ltd.	478	10	13.8	-23	223	-10	7.9	5
Tembec[5]	238	-15	18.4	-46	186	6	-29.8	-294
Weldwood	684	-11	5.4	-92	353	1	-7.4	-156
West Fraser Timber	541	-2	3.4	-88	253	-13	-8.2	-182
Total[6]	19,991	-8	-248.5	-121	9,269	-12	-438.7	-323

1. Full-year 1990 earnings include the following nonrecurring, extraordinary, unusual, and/or discontinued gains (losses) in millions: Abitibi Price, ($35); Canfor, $24; Cascades, $3; Doman, $15; Domtar, ($198); Fletcher Challenge Canada, $21; Rolland, $5.

2. 1989 earnings include the following nonrecurring, extraordinary, unusual, and/or discontinued gains (losses) in millions: Abitibi Price, ($17); Cascades, $5; Domtar, ($3); Fletcher Challenge Canada, ($24); Rolland, ($4.5).

3. First-half 1991 earnings include the following nonrecurring, extraordinary, unusual, and/or discontinued gains (losses) in millions: Abitibi Price, ($20) pretax; Canfor, $5.8; Tembec, ($32.1).

4. First-half 1990 earnings include the following nonrecurring, extraordinary, unusual, and/or discontinued gains (losses) in millions: Abitibi Price, ($42.6) pretax; Canfor, $26.2; Domtar, ($30); Fletcher Challenge Canada, $20.7.

5. Tembec has a September fiscal year end. 1991 results reflect first nine months of fiscal 1991.

6. Noranda Forest is a majority owner of MacMillan Bloedel and fully consolidates MB's sales. In order to prevent double counting, all MacMillan's sales and half of its reported net income are not included in the totals.

Forest chairman Adam Zimmerman noted that "the [forest products] industry cannot absorb the effects of adverse exchange rates and interest costs at a time when volumes and prices in most products have declined 20% to 30%." He added that it is extremely urgent for industry's partners in labor and government to recognize the current reality and jointly take corrective action.

Repap Enterprises Corp. Inc. is relatively unique among the major paper companies in Canada in that none of its revenue is derived from newsprint and only a minority comes from pulp (and lumber) sales. Instead, Repap possesses a modern portfolio of mills oriented to the higher-value-added coated paper markets (60% of 1990 sales), with half of its coated paper manufacturing base in the U.S. Unfortunately, Repap's profitability has been all too similar to that of its Canadian competitors, as the company's earnings have been weighed down by immense interest expense. In 1990, Repap achieved a small $3.1-million profit, but as product prices weakened in 1991, results crashed to a $52.1-million deficit for the first six months.

LOOKING AHEAD

Although the direction of certain crucial factors, such as exchange rates, is difficult to forecast, the overall prognosis for the Canadian forest products industry is dim. First, the supply/demand outlook for the industry's two most important products, newsprint and market pulp, is unfavorable due to excess capacity growth and potentially damaging structural changes in worldwide demand from, most notably, a shift to recycled-content products (lumber, the third mainstay of the industry, faces a mixed future). Accordingly, given anything less than a surge in the economy, pricing could well remain relatively depressed for these key products. Moreover, since the Canadian industry contains some of the oldest, most inefficient mills in the world as well as a highly paid labor force, it is likely to bear a disproportionately heavy brunt of mill closures. Finally, as exemplified by Repap and Noranda Forest, Canadian companies are buried under mountains of debt. This translates into high interest expense, which further depresses profits.

Canada:

CAPACITY EXPANSION

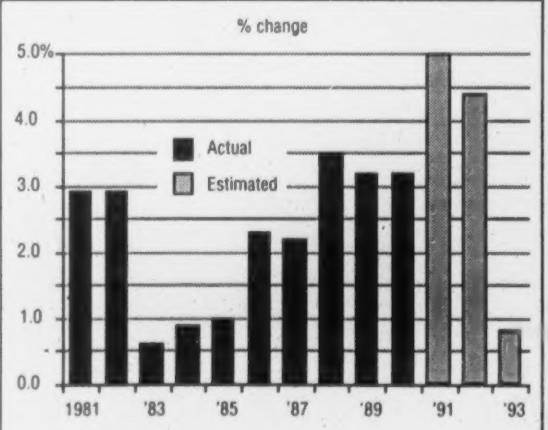
Growth plans were above normal in the Canadian industry from 1986-89. Companies recovered from the hard times of the early 1980s and began expanding in grades such as higher-value printing/writing paper and mechanical market pulp—products that require less capital than chemical grades. Then in 1988, nearly every major producer seemed ready to add newsprint capacity. While plans for new machines skyrocketed over the 1989-92 period, climbing at the highest rate in several decades, kraft pulp expansion plans also picked up in 1988, with a push from Japanese companies.

Business conditions began to sour in 1989, and although the expansion boom continued to take shape, some producers began to delay or cancel expansion plans. Newsprint markets weakened first, and the pulp export market soon followed. In 1990, the industry found itself in the middle of a capacity expansion boom in its major grade segments just as markets were turning down dramatically. Although capital spending plans plunged, the overall growth pattern will still be above average through 1993 since the original expansion plans were ambitious.

Canadian paper and paperboard capacity will grow at an average annual rate of 3.4% over the next few years, according to the Canadian Pulp & Paper Assn.'s annual survey of capacity expansion plans. This rate is down from last year's projected rate of 4.7%, which was more than twice as strong as in the preceding ten years. In paper and board, a 3.39% growth rate will still be greater than the 2.25% rate for 1980-90. Pulp will grow at a 2.26% rate in the next three years, from 1.95% in 1980-90, and market pulp will grow significantly greater at 5.1%, over 1.99% in the previous decade.

Total Canadian paper and paperboard capacity (excluding building and construction board) will climb from 18.9 million metric tons in 1990 to 20.9 million tons in 1993. Total pulp capacity will climb 5.1% over the same period, from 26.5 million metric tons in 1990 to 28.3 million tons in 1993. Market pulp capacity, which accounts for about one-third of total pulp capacity, will rise 5.1% over the next three years, from 8.8 million tons in 1990 to 10.2 million tons in 1993.

The rate of expansion forecast by CPPA for the next few years may be affected by a rash of shutdowns at Canada's newsprint mills. Industry analysts say as many as 20 to 40 machines may be shut down in the next two years, amounting to 500,000 to 2 million tpy of newsprint. Abitibi-Price Inc. has shut down its 170,000-metric-tpy newsprint mill in Thunder Bay, Ont., for at least two years. The big newsprint manufacturers—Canadian Pacific Forest Products Ltd., Kruger Inc., and Donohue Inc.—have had temporary or permanent shutdowns. Some analysts predict the newsprint market will suffer a downtrend lasting far beyond the


PAPER AND PAPERBOARD CAPACITY GROWTH

Source: Canadian Pulp & Paper Assn.

CANADIAN INDUSTRY CAPACITY

(000 metric tons)

MARKET PULP

		Sulfate paper grades									
Year	Sulfite paper grades	Total	Bleached softwood	Semi-bleached softwood	Bleached hardwood	Unbleached	Total chemical paper grades	Dissolving & special alpha	Mechanical	Total market pulp capacity	% increase from previous year
1993e	303	7,828	6,144	296	1,283	105	8,131	247	1,851	10,229	2.4%
1992e	302	7,784	6,106	293	1,280	105	8,086	247	1,659	9,992	5.2
1991e	301	7,592	5,946	307	1,234	105	7,893	247	1,359	9,499	7.8
1990	316	7,144	5,685	313	1,027	119	7,460	247	1,104	8,811	-0.1
1989	343	7,103	5,714	316	969	104	7,446	281	1,090	8,817	4.8
1988	323	7,067	5,665	376	913	113	7,390	277	745	8,412	2.8
1987	331	7,004	5,533	473	873	125	7,335	245	599	8,179	2.4
1986	316	6,835	5,396	501	809	129	7,151	245	589	7,985	6.4
1985	305	6,624	5,233	420	794	177	6,929	266	574	7,769	1.3
1984	279	6,606	5,134	405	869	198	6,885	264	521	7,670	0.1
1983	322	6,571	5,130	453	780	208	6,893	267	500	7,660	0.6
1982	369	6,471	5,128	438	669	236	6,840	305	472	7,617	2.5
1981	397	6,413	5,056	433	634	290	6,810	303	317	7,430	2.7

PAPER AND BOARD

Year	Newsprint[1]	Uncoated mechanical	Uncoated woodfree	Kraft papers	Tissue sanitary, special[2]	Containerboard	Boxboard	Total (excluding building, other)	Building, other[3]	Total paper/board capacity	% increase from previous year
1993e	10,990	2,223	1,602	539	713	2,329	979	20,173	730	20,903	0.8%
1992e	10,925	2,243	1,557	537	708	2,328	953	20,006	730	20,736	4.4
1991e	10,430	2,097	1,498	533	675	2,279	917	19,131	729	19,860	5.0
1990	10,100	1,880	1,428	508	636	2,145	878	18,185	728	18,913	3.2
1989	10,020	1,843	1,316	512	572	2,056	795	17,614	716	18,330	3.2
1988	9,945	1,668	1,046	560	561	2,039	767	17,061	706	17,767	3.5
1987	9,855	1,407	931	579	521	1,965	773	16,501	666	17,167	2.2
1986	9,800	1,347	892	579	509	1,901	775	16,158	646	16,804	2.3
1985	9,725	1,135	898	541	502	1,869	798	15,783	649	16,432	1.0
1984	9,710	1,020	1,126	531	503	1,849	798	15,537	740	16,277	0.9
1983	9,885	875	1,026	554	486	1,794	767	15,387	751	16,138	0.6
1982	9,920	765	1,008	527	492	1,799	758	15,269	767	16,036	2.9
1981	9,490	660	1,019	566	467	1,884	792	14,878	711	15,589	2.9

e = Estimate.

1. Figures have not been adjusted for changes in grammage of newsprint, and they are not directly comparable year to year.
2. Includes glassine and greaseproof papers.
3. Includes wet machine board.

Source: Canadian Pulp and Paper Assn.

Note: In its 1989 report on capacity expansion plans, CPPA replaced two old categories of printing/writing papers with four new categories. "Uncoated mechanical" replaces "Groundwood Printing & Specialty" with no change in data. "Uncoated woodfree" replaces "Book, Fine & Misc. Fine," but data are the same only through 1984. CPPA also added two categories of coated paper with data back to 1985:

Year	Coated mechanical	Coated woodfree
1993e	623	175
1992e	600	155
1991e	577	125
1990	495	115
1989	380	120
1988	345	130
1987	330	140
1986	215	140
1985	175	140

current recession. Pulp manufacturers may also experience more shutdowns. Cascades Port Cartier Inc. shut down its 180,000-tpy bleached chemi-thermomechanical pulp mill in second-quarter 1991.

Canada is the world's largest producer of paper-grade market pulp, with 27% of total world capacity in 1990. About 90% of the country's market pulp is exported since most Canadian paper mills are integrated. British Columbia produced 50.9% of Canada's total market pulp capacity in 1990, followed by Quebec with 15.2%, Ontario with 13.7%, and New Brunswick with 9.5%. Although some Canadian companies are cutting back on expansion plans, expansion activity is still strong enough to keep growth well above the ten-year average over the next three years.

Market pulp producers plan to add 1.4 million tons in 1991-93, raising overall capacity 16.1% to 10.2 million tons annually, at an average annual growth rate of 5.1%. This is sharply higher than the 2.0% rate recorded in the 1980-90 period. The share of total capacity attributable to the mechanical grades will rise from 12.5% in 1990 to 18.1% by 1993. Mechanical pulp capacity will jump 747,000 tons as a result of the startup of chemi-thermomechanical pulp (CTMP) lines at five locations: Donohue Matane Ltd., Matane, Que.; Louisiana-Pacific Corp., Chetwynd, B.C.; Millar Western Pulp Ltd., Meadow Lake, Sask.; and Slave Lake Pulp Corp., Slave Lake, Alta.

Sulfate capacity will rise 684,000 tons from 1990 to 1993. More than two-thirds of this increase is represented by bleached softwood sulfate expansion projects at Weldwood of Canada Ltd., Hinton, Alta.; Daishowa Canada Co. Ltd., Peace River, Alta.; and Howe Sound Pulp & Paper Ltd., Quesnel, B.C. Bleached softwood sulfate capacity will grow by 459,000 tons, or 8.1%, over the next three years.

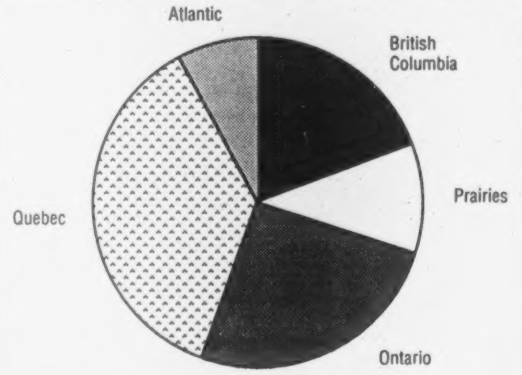
Bleached hardwood sulfate capacity will rise by 356,000 tons, or 34.9%, with almost all of the new tonnage coming from two projects: Daishowa Forest Products Ltd., Peace River, Alta., and James Maclaren Industries Inc., Thurso, Que.

A jump in mechanical pulp capacity of 1.2 million tons, or 9.9%, will account for about two-thirds of the new tonnage due to come onstream between 1990 and 1993. CTMP and thermomechanical pulp capacity will rise by 1.7 million tons, or 24.6%, over the next three years, while capacities for stone groundwood and atmospheric refiner pulps are expected to decrease by 323,000 and 159,000 tons, respectively. This is mainly due to the startup of Canadian Pacific Forest Products' deinking lines at its newsprint mills in Thunder Bay and in Gatineau, Que.

An overall increase of 605,000 tons, or 4.5%, is expected in chemical pulps in the next few years. In the period 1990-93, sulfite pulp capacity will rise by 898,000 tons, or 7.6%. The bleached and semibleached softwood sulfate category will be 579,000 tons higher in 1993 than in 1990. This represents an average annual increase of 2.2% over the three-year period, well above the 1.3% rate recorded from 1980 to 1990. Capacity for bleached hardwood sulfate will advance by 18.2% during the survey period. The supply of unbleached sulfate will remain virtually unchanged. The startup of two deinking projects—Daishowa Forest Products, Quebec City, Que., and Canadian Pacific Forest Products, Thunder Bay—will cause a 294,000-ton drop in the capacity to manufacture unbleached sulfite pulp.

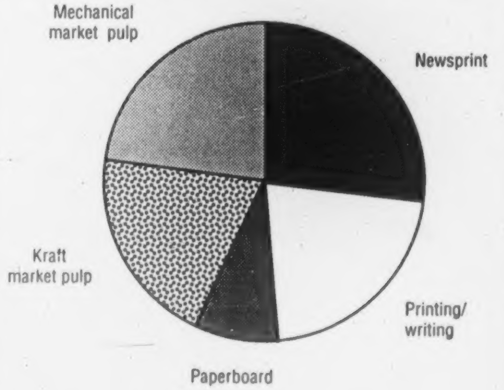
Canada's largest grade sector, newsprint, is still in the midst of an expansion boom, marking the first period of strong growth since 1981-82. Capacity will rise from 10.1 million tons in 1990 to 10.9 million tons in 1993, an increase of 8.8%. Capacity will rise an average of 2.8% a year through 1993, compared with average growth of just 1.0% during 1980-90. Losses in capacity due to the retirement of some machines and the conversion of others to pro-

CAPACITY EXPANSION PLANS BY REGION, 1990-93



Source: Canadian Pulp & Paper Assn.

CAPACITY EXPANSION PLANS BY GRADE, 1990-93



Source: Canadian Pulp & Paper Assn.

NEW MILLS AND PAPER MACHINES ANNOUNCED FOR CANADA

Company	Location	Project	Grade	Capacity (metric tpy)
Started up in 1987				
CIP	Gatineau, Que.	New machine	Newsprint	175,000
Domtar	Windsor, Que.	New machine	Uncoated free-sheet	175,000*
Donohue	Clermont, Que.	New machine	Newsprint	180,000
Started up in 1988				
Consolidated-Bathurst	Bathurst, N.B.	New machine	Corrugating medium	150,000*
Fibreco Export	Taylor, B.C.	New mill	Bleached CTMP	180,000
Millar Western	Whitecourt, Alta.	New mill	Bleached CTMP	210,000
St. Marys Paper	Sault Ste. Marie, Ont.	New machine	SC groundwood	118,000
Weyerhaeuser Canada	Prince Albert, Sask.	New machine	Uncoated free-sheet	220,000
Started up in 1989				
Canadian Pacific Forest Products	Dryden, Ont.	New machine	Uncoated free-sheet	175,000
Canadian Pacific Forest Products	Gold River, B.C.	New mill	Newsprint	225,000
Cascades	Kingsey Falls, Que.	New machine	Tissue	25,000
Domtar	Windsor, Que.	New machine	Uncoated free-sheet	175,000*
Finlay Forest Industries	Mackenzie, B.C.	New machine	Newsprint	216,000
Repap Enterprises	Newcastle, N.B.	New machine	Coated paper	260,000
Tembec	Temiscaming, Que.	New machine	Bleached paperboard	110,000
Vicell Canada Tissue	Delta, B.C.	New mill	Tissue	9,000
Started up in 1990				
Alberta Newsprint	Whitecourt, Alta.	New mill	Newsprint	220,000
Daishowa Canada	Peace River, Alta.	New mill	Bleached kraft pulp	340,000
Donohue	Matane, Que.	New mill	Bleached CTMP	190,000
Irving Pulp & Paper	St. John, N.B.	New machine	Tissue	60,000
Tembec	Temiscaming, Que.	New machine	Bleached paperboard	140,000
For startup in 1991				
Atlantic Packaging/Newsprint	Whitby, Ont.	New mill	Tissue/Newsprint	180,000
Canadian Pacific Forest Products	Thunder Bay, Ont.	New machine	Newsprint	240,000*
Howe Sound Pulp & Paper	Port Mellon, B.C.	New mill	Newsprint	200,000
Kruger	Trois Rivières, Que.	New machine	Newsprint	180,000*
Louisiana-Pacific	Chetwynd, B.C.	New mill	Bleached CTMP	155,000
Perkins Papers	Candiac, Que.	New machine	Tissue	50,000
Slave Lake Pulp	Slave Lake, Alta.	New mill	Bleached CTMP	110,000
Stone-Consolidated	Grand'Mère, Que.	New machine	Groundwood specialties	190,000*
For startup in 1992				
Consumers Paper	Redcliff, Alta.	New mill	Tissue	25,000
Interchem Industries	Port Clement, B.C.	New mill	Sulfite pulp	35,500
Millar Western	Meadow Lake, Sask.	New mill	Bleached CTMP	240,000
Proposed (no startup date announced)				
Alberta-Pacific Forest	Athabasca, Alta.	New mill	Bleached kraft pulp	500,000
Fibreco Export	Taylor, B.C.	New mill	Bleached CTMP	180,000
Nortek Forest Products	Nipawin, Sask.	New mill	Mechanical pulp	110,000
Orenda Forest Products	Stewart, B.C.	New mill	Bleached CPGW	108,500
Repap Enterprises	The Pas, Man.	New mill	Bleached kraft pulp	428,500
Shin Ho Canada	Thunder Bay, Ont.	New mill	Bleached CTMP	150,000
Stake Technology	Rimouski, Que.	New mill	Mechanical pulp	100,000
Takema Forest	Fort Nelson, B.C.	New mill	Bleached CTMP	190,000

*Replaces some existing capacity.
CTMP = Chemi-thermomechanical pulp.
CPGW = Chemi-pressurized groundwood.

duce nonnewsprint grades will be more than offset by improvements to existing facilities and the startup in 1991 of four new machines: Atlantic Newsprint Co., Whitby, Ont.; Canadian Pacific Forest Products, Thunder Bay; Howe Sound Pulp & Paper, Port Mellon, B.C.; and Kruger, Trois Rivières, Que. The current expansion boom was originally expected to be much larger, although it is still larger than any growth period since the 1970s.

Capacity for printing/writing grades will rise 18.0% between 1990 and 1993, from 3.9 million tons to 4.6 million tons, but this is down from last year's projected rate of 29.7%. Although coated groundwood will have the highest rate of growth as it increases 25.9%, from 495,000 tons to 623,000 tons, this is down from last year's projected three-year increase of 62%. It reflects continued capacity coming onstream from Repap Enterprises Corp. Inc.'s machine at Newcastle, N.B., which started up in 1990. The decrease in projected growth results from postponement of four major coated groundwood projects. Boise Cascade Corp., Blandin Paper Co., Bowater Inc., and Fraser Inc. have postponed projects representing approximately 900,000 to 1 million tpy of new capacity. Coated free-sheet will move up by 60,000 tons, or 52.2%, due mainly to new coating capacity at Island Paper Mills Co. in New Westminster, B.C.

Uncoated groundwood will grow 18.2%, or 343,000 tons, from 1990 to 1993. Almost half of this will come from Stone-Consolidated Inc.'s new paper machine at Grand'Mère, Que., which started up earlier this year. Uncoated free-sheet is projected to increase by 174,000 tons, or 12.2%, from 1990 to 1993, as two machines that started up during second-half 1989 reach their full capacity: Domtar Inc. at Windsor, Que., and Canadian Pacific Forest Products at Dryden, Ont.

Sanitary tissue capacity will grow 12.1% between 1990 and 1993, adding 77,000 tons of capacity, as four projects that started up in 1989 and 1990 reach full capacity: Atlantic Packaging Products Ltd., Whitby; Irving Tissue Ltd., Saint John, N.B.; Cascades Inc., Kingsey Falls, Que.; and Perkins Paper Ltd., Candiac, Que.

Containerboard capacity will increase by 184,000 tons, or 8.6%, owing mainly to additional supply from Eurocan Pulp & Paper Co. in Kitimat, B.C. Boxboard capacity will expand from 878,000 tons in 1990 to 979,000 tons in 1993. This increase of 11.5% mainly reflects the startup in 1990 of Tembec Inc.'s new solid bleached boxboard machine in Temiscaming, Que.

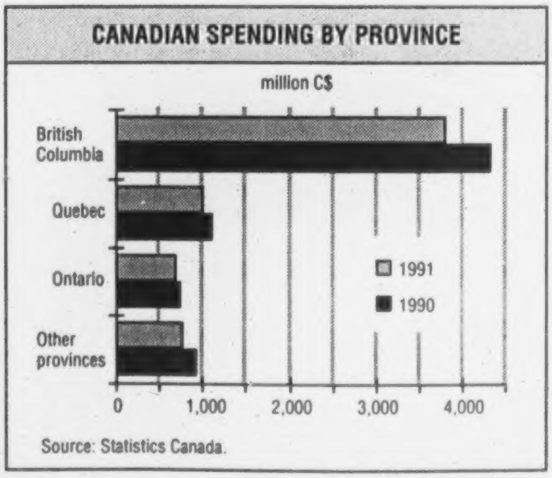
Canada:

CAPITAL SPENDING

The 1990-91 recession hit Canadian pulp and paper companies hard, leading to a sharp drop in capital spending plans for 1991. Spending is down for the second straight year, as the industry retrenches in response to lower earnings and severe overcapacity.

In *Pulp & Paper Project Report*'s summer 1991 survey of spending, companies reported plans to spend C$8.3 billion on mill projects during the 1991-93 period, down 11.7% from plans reported in July 1990 for the 1990-92 period. These results echoed a survey by Statistics Canada that forecast a decline of 12.2% in 1991 outlays to $3.81 billion. The decline forecast for Canada is smaller than in the U.S. but comes on top of a 14.8% drop in 1990, when U.S. spending was still rising.

As in the U.S., the capacity expansion boom that drove spending plans to record levels in the late 1980s played itself out in 1991, leaving environmental improvements as the main engine of capital spending. In Canada, environmental outlays reported in the July 1991 survey comprised 36% of planned improvement projects at existing mills, up from 24% in the July 1990 survey and just 8% in July 1989. Mills will be scrambling to comply with stricter regulations covering dioxin formation, odor control, and secondary treatment.


CANADIAN SPENDING BY PROVINCE

Source: Statistics Canada.

The Canadian Pulp & Paper Assn. estimates that the industry must spend approximately $3 billion a year to maintain and upgrade facilities to improve productivity and competitiveness. While markets remain weak, mills will cut back on expansion projects and concentrate their efforts in the environmental area.

Plans for further pulp capacity increases in Canada have made a bit of a comeback in the face of stiff environmental opposition. Alberta-Pacific Forest Industries' $1.3-billion kraft pulp mill proposal got the green light in early 1991 after a series of delays that almost killed the project, and Celgar Pulp Co.'s $700-million facelift at Castlegar, B.C., passed environmental review by a newly formed provincial panel.

Projects to be completed in 1991 accounted for C$2.9 billion of reported Canadian outlays in the *Project Report* survey. Through mid-1991, companies had announced plans to spend $1.9 billion on projects for startup in 1992, $2.8 billion in 1993, and $663 million in 1994-95. Proposed projects have multiplied, rising 55% over last year to $5.8 billion. Many of these proposals, however, are for greenfield projects, which will be hard to finance given current market conditions.

GEOGRAPHIC BREAKDOWN

During the past decade, the pattern of provincial expenditures has shifted in focus from western Canada to eastern Canada and then back again. Until 1982, British Columbia and Alberta led the field in total dollar amounts, capacity expansion, and greenfield mill plans. After 1982, spending programs in Ontario and Quebec eclipsed the western provinces. Weak markets and high production costs dealt a heavy blow to British Columbian companies during the recessions of the early 1980s, while in Quebec and Ontario, federal aid designed to modernize the industry helped some eastern companies when the economy forced internal cutbacks. Recently, however, emphasis on capacity expansion has shifted the advantage back to resource-rich western Canada.

In the 1991 Statistics Canada survey, mills in British Columbia reported plans to spend $1.3 billion in 1991, down 14.6% from outlays of $1.5 billion in 1990. Spending for machinery and equipment will fall 17.1% to $1.1 billion, while construction costs will climb 6.8% to $170 million. The decline planned for 1991 follows gains of 5.5% in 1990 and 59.9% in 1989.

In Quebec, companies reported plans to spend $1.02 billion in 1991, down 9.6% from 1990 outlays of $1.13 billion. Spending for construction will decline 12.0% to $125 million, while spending for equipment and machinery drops 9.3% to $894 million.

Spending in the "other" provinces of Alberta, Saskatchewan, Manitoba, and the Maritimes was expected to drop 15.3% in 1991 to $793 million. The decline comes on top of a sharp 43.2% decline in 1990 spending after the delay of major expansion projects in Alberta. Construction spending in the other provinces was set to suffer a 51.7% decline to $85 million in 1991, while outlays for machinery were expected to dip 6.8% to $708 million.

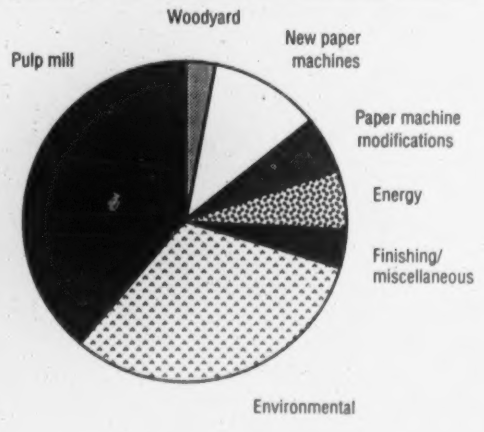
In Ontario, companies reported plans to spend $710 million on capital improvements in 1991, down 7.6% from 1990 spending of $769 million. Construction costs were estimated at $40 million, down 43.7% from 1990, while machinery outlays were expected to total $670 million, off 4.0% from 1990.

HISTORICAL PATTERN

The past ten years have been a roller coaster ride for capital spending in Canada. Canadian pulp and paper companies boosted capital expenditures dramatically during the late 1970s, when government assistance programs spurred outlays as the industry was gearing up for a heavy round of expansion. Total yearly outlays rose from $607 million in 1978 to a peak of $2.05 billion in 1981, an increase of 238%. However, that situation reversed itself quickly in the back-to-back recessions of the early 1980s, when companies slashed expenditures on nonessential items. Spending in 1983 dipped to $903 million, down 48% from 1982 and down 56% from the 1981 peak.

The economic picture began to brighten during second-

ESTIMATED CAPITAL SPENDING BY PROCESS AREA, 1991-93+



Source: *Pulp & Paper Project Report.*

TOP SPENDERS IN CANADIAN INDUSTRY

(000 C$)

Company	1991-93+
Abitibi-Price	C$61,500
Alberta-Pacific Forest Industries	1,280,000
Boise Cascade Canada	264,631
Canadian Forest Products	223,373
Canadian Pacific Forest Products	211,000
Cariboo Fibreboard	140,000
Cariboo Pulp & Paper	71,696
Cascades (and subsidiaries)	66,205
Celgar Pulp	700,000
Daishowa Forest Products	83,000
Domtar.	65,000
Eddy Forest Products	134,682
Fletcher Challenge Canada	589,390
Howe Sound Pulp & Paper	210,000
James River-Marathon	373,333
Kruger	54,690
Louisiana-Pacific	150,000
MacMillan Bloedel	412,200
Malette Kraft Pulp & Power	275,000
Millar Western Pulp	330,000
Newstech Recycling	83,000
Northwood Pulp & Timber	51,461
Perkins Papers.	67,375
Quebec & Ontario Paper	162,190
Repap Enterprises	107,565
Scott Paper	110,000
Stone-Consolidated	345,900
Tembec	754,023
Weldwood of Canada	51,600
Western Pulp Limited Partnership	114230
Weyerhaeuser Canada	52,000

Note: Totals based on spending plans for pulp and paper mills only, including both production and environmental improvements.
Source: *Pulp & Paper Project Report.*

half 1983, although more slowly in Canada than in the U.S.; by late 1984, capital spending plans were back on track at prerecession levels. Spending recovered modestly in 1984 to $1.01 billion, a gain of 12%, and exploded in 1985 back above the $2-billion mark.

The big increase in 1985 spending was somewhat surprising, considering that Canadian companies had not fully recovered from the recession. Low prices and increased offshore competition put the squeeze on profit margins during this period, and the industry was also still saddled with debt from the big spending increases of 1980 and 1981. A *Pulp & Paper* magazine survey in late 1985 found a 10% decrease in reported spending plans as many companies continued to defer spending programs. Nevertheless, capital outlays soared to $2.04 billion for the year, a 100% increase over the 1984 level.

The profit picture improved considerably in 1986, but capital spending slipped from the near-record 1985 pace to $1.89 billion, down 7%. Statistics Canada figures show that producers spent about 13% less in 1986 than they originally planned. Spending climbed to a record $2.54 billion in 1987 on the strength of record earnings and accelerating expansion plans, a gain of 35%. The stock market crash of October 1987 added a temporary note of uncertainty to the outlook, but companies quickly resumed an aggressive posture, pushing spending up 44% to $3.65 billion in 1988.

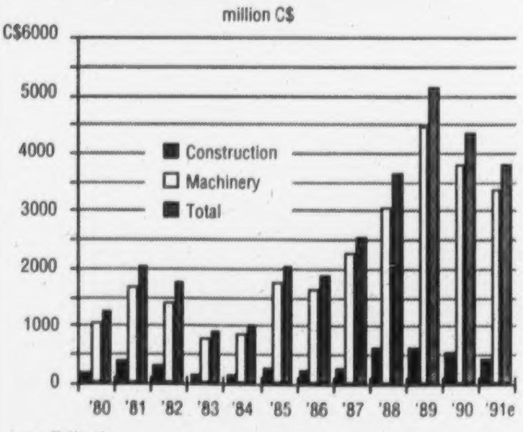
While efforts during the middle of the past decade were focused on cost containment and productivity improvement, spending plans in the late 1980s were driven mainly by capacity expansion, particularly in newsprint, market pulp, and fine papers. In 1989, newsprint producers began a huge buildup in capacity lasting into 1991. Chemical market pulp producers geared up for a similar glut of new capacity, although some projects were later delayed. Much of this pulp mill spending was funded by overseas interests, particularly the Japanese, who have found North America a cheap place to invest at current exchange rates. More so than in the U.S., capital spending in Canada got a boost from overseas investment. Of ten major expansion programs announced in 1988, five of the largest involved major investments by overseas papermakers.

Entrepreneurial investment has also been a major factor in Canadian spending plans. Led by Repap Enterprises Corp. Inc., companies such as Cascades Inc. and St. Marys Paper Inc. that have rescued and rejuvenated old mills are responsible for a share of spending out of proportion to their size. Another group of entrepreneurs has come in from outside the industry and built new capacity, especially in the West. Millar Western Pulp Ltd., for example, entered the industry by building a new chemi-thermomechanical market pulp mill in Alberta in 1988, and it is building another mill for startup in 1992 in Saskatchewan.

Capacity growth rates have been higher than average in the Canadian industry since 1986, culminating in record expansion plans at the end of the decade. Business conditions began to sour in 1989, but the expansion boom continued to take shape, and in 1990, the industry found itself in the middle of a capacity expansion boom in its major grade segments as well as in a steep market downturn. Capital spending plans plunged, and the three-year outlook for capacity expansion dropped 20%. The expansion boom was originally expected to be much larger than it has turned out to be, although it is still larger than any growth period since the 1970s. Collapsing prices put the squeeze on newsprint companies in 1989, resulting in a series of project cancellations, postponements, shutdowns of high-cost capacity, and conversions to other grades.

After three years of record increases, Canadian pulp and paper companies cut back on capital spending in 1990. According to Statistics Canada, the industry spent $4.34 billion on capital projects in 1990, down 21.1% from 1989.

CONSTRUCTION VS MACHINERY COSTS IN CANADIAN CAPITAL SPENDING



e = Estimate.
Source: Statistics Canada.

CAPITAL SPENDING PLANS OF MAJOR CANADIAN PAPER COMPANIES

(million C$)

	1991e	1990	% change
Abitibi-Price	C$60	C$107	-43.9%
Canfor	60	105	-42.9
Cascades	75	93	-19.4
Domtar	100	200	-50.0
Fletcher Challenge	243	248	-2.0
MacMillan Bloedel	300	367	-18.3
Noranda Forest	380	569	-33.2
Repap	57	355	-83.9
Total	**1,275**	**2,044**	**-37.6**

e = Estimate.
Source: *1991 Pulp & Paper Company Profiles.*

Spending for machinery and equipment totaled $3.78 billion, down 15.8% from 1989, while outlays for construction dropped 45.1% to $549 million.

SPENDING BY CATEGORY

In *Pulp & Paper*'s late 1990 survey of spending, Canadian companies reported plans to spend C$10.2 billion on capital projects during the 1990-92 period, down 21.1% from plans reported in 1989 for the 1989-91 period. Production-related projects accounted for $7.6 billion of overall spending, down 29.5% from the previous survey. Spending was down in every part of the mill, led by a 46.5% drop in installations of new paper machines. Pulp mill improvements, the largest category in dollar terms, totaled $4.5 billion, down 20.7% from 1989.

Environmental expenditures climbed to $2.5 billion for 1990-92, up 23.2% from plans reported for 1989-91. Spending for water quality improvements posted an 18.9% gain to $1.9 billion, following a 506% gain the previous year and a 122% increase the year before that. Companies reported air pollution control projects costing $562 million for 1990-92, up 45.4% from 1989-91. Spending for solid waste disposal was down 2.9%, however, to $68 million.

Two major bleached softwood kraft pulp expansion projects were completed in 1990 at existing mills: Howe Sound Pulp & Paper Co. Ltd.'s 350-tpd expansion at Port Mellon, B.C., and Weldwood of Canada Ltd.'s 215,000-tpy doubling of capacity at Hinton, Alta. In addition, Daishowa Canada Co. Ltd. recently brought online its new 340,000-tpy mill in Peace River, Alta.

In late 1991, Fletcher Challenge Canada Ltd. and James River-Marathon Ltd. were scheduled to complete major improvement programs adding 75,000 tpy and 178,500 tpy, respectively. A 235,000-tpy expansion program at Celgar Pulp's Castlegar mill is to be completed in mid-1992.

Bleached hardwood kraft pulp capacity will jump 391,000 tpy by 1992 to 1.36 million tons, a substantial 40.4% increase over 1989, according to CPPA. Most of the extra capacity will result from three sources: Daishowa Canada's new Peace River mill; James Maclaren Industries Inc.'s 75,000-tpy expansion at Thurso, Que., in 1990; and Malette Inc.'s 1990-92 modernization program at Smooth Rock Falls, Ont., adding about 70,000 tpy of softwood and hardwood kraft output.

Mechanical market pulp has been one of the fastest growing sectors in Canada, but because of depressed markets it is unclear exactly how much of the announced new capacity will actually be built. Most observers report that mills are holding back until conditions improve.

Donohue-Matane Inc. and Slave Lake Pulp Corp. completed new bleached chemi-thermomechanical pulp (BCTMP) mills in late 1990. The Donohue mill in Matane, Que., has capacity for 190,000 tpy, while the Slave Lake, Alta., mill will produce 110,000 tpy. Louisiana-Pacific Corp. completed its new 157,500-tpy BCTMP plant in Chet-

PAPER AND ALLIED INDUSTRIES' CAPITAL AND REPAIR EXPENDITURES

(million C$)

	Capital spending			Repair expenditures		
Year	Construction	Machinery/ equipment	Total	Construction	Machinery/ equipment	Total
1991e	C$420.6	C$3,388.6	C$3,809.2	C$134.7	C$2,102.5	C$2,237.2
1990	549.0	3,790.4	4,339.4	147.4	1,988.2	2,135.6
1989	639.6	4,493.9	5,133.5	118.7	1,752.8	1,871.5
1988	603.0	3,051.6	3,654.6	100.7	1,668.1	1,768.8
1987	255.5	2,286.5	2,542.0	92.2	1,514.7	1,606.9
1986	232.8	1,656.8	1,889.6	89.6	1,088.1	1,177.7
1985	263.5	1,772.1	2,035.6	83.1	1,051.7	1,134.8
1984	154.2	860.1	1,014.3	81.3	850.1	931.4
1983	140.9	762.2	903.1	66.5	751.5	818.0
1982	323.2	1,420.0	1,743.2	70.0	783.5	853.5
1981	375.6	1,676.0	2,051.6	71.5	761.6	833.1
1980	192.3	1,040.7	1,233.0	68.4	682.4	750.8
1979	77.8	685.3	763.1	59.2	604.0	663.2
1978	94.3	513.0	607.3	48.2	487.5	535.7
1977	168.9	521.3	690.2	35.1	445.7	480.8
1976	114.7	490.1	604.8	36.5	417.1	453.6
1975	87.0	399.9	486.9	24.1	315.0	339.1
1974	102.9	365.8	468.7	28.7	348.0	376.7
1973	77.1	264.8	341.9	17.5	264.3	281.8
1972	100.4	267.8	368.2	13.9	196.8	210.7
1971	128.3	377.9	506.2	11.6	207.0	218.6
1970	122.3	366.0	488.3	12.5	189.8	202.3
1969	97.1	228.6	325.7	11.5	177.0	188.5
1968	58.2	181.9	240.1	10.7	157.0	167.7
1967	99.0	319.5	418.5	10.6	158.1	168.7
1966	127.2	379.2	506.4	12.3	139.1	151.4
1965	102.2	281.6	383.8	12.9	118.5	131.4
1964	64.7	229.0	293.7	9.2	112.7	121.9
1963	36.4	145.2	181.6	11.0	96.8	107.8
1962	34.5	113.3	147.8	10.5	96.2	106.7
1961	33.1	105.3	138.4	7.7	92.6	100.3

e = Estimate.
Source: Statistics Canada.

wynd, B.C., in early 1991.

Alberta Newsprint Co. Ltd. started up its new 220,000-tpy newsprint mill at Whitecourt, Alta., in fall 1990, and Atlantic Packaging Products Ltd. brought a new 150,000-tpy machine online in early 1991, as did Canadian Pacific Forest Products Ltd. and Kruger Inc. CPFP's new 240,000-tpy No. 5 machine at Thunder Bay, Ont., will replace two older units for a 60,000-tpy net increase in capacity. Kruger's new machine at Trois Rivières, Que., will have capacity for 180,000 tpy, but about 70,000 tpy of the increase will be offset by conversion of No. 4 machine at Corner Brook, Nfld., to produce supercalendered paper.

The final machine to come online in this round of expansions was at Howe Sound Pulp & Paper's new 535-tpd Port Mellon mill, started up in July 1991.

Four new machines will raise sanitary papers capacity by 31.4% to 666,000 tons in 1992. Atlantic Packaging Products, Whitby, Ont., and Irving Tissue Ltd., Saint John, N.B., each added a new machine early in 1990, and a third machine started up in early 1990 at Cascades's Kingsey Falls, Que., mill. In mid-1991, Perkins Paper Ltd. started up a new tissue unit at Candiac, Que.

Canada:

MERGERS AND ACQUISITIONS

Current trends in the Canadian pulp and paper industry indicate a consolidation and retrenchment of operations that is following earlier patterns of foreign investment and expansion. The 1990 recession, especially in the form of abysmal newsprint and pulp markets, promised to spur a fundamental restructuring of the Canadian industry in the coming years. Among companies' attempts to shake off unprofitable and unwanted operations were employee buyout offers that took advantage of the government's desperation to save needed jobs in remote areas of the country.

The biggest such deal, and the largest acquisition in Canada in 1991, was the agreement reached between Kimberly-Clark Corp. of the U.S. and the provincial government of Ontario, in which ownership of the Spruce Falls Power & Paper Co. Ltd. mill in Kapuskasing, Ont., would be given to employees, providing that the province buy the mill's hydroelectric power plant for C$140 million. Along that line, Abitibi-Price Inc. sought to sell its Pine Falls, Man., newsprint mill to an employee-management group, while provincial governments stepped in to help shore up mills in Quebec and New Brunswick. But competitors and Canadians themselves began to question the legitimacy of such costly support for manufacturing plants that perhaps have seen the end of their usefulness.

Spruce Falls deal. After months of complex negotiations, an agreement was hammered out in August 1991 in which Kimberly-Clark and The New York Times Co., owners of the Spruce Falls operations, would sell the newsprint mill to a partnership of the mill's employees and Tembec Inc. for $60 million in exchange for the province's purchase of a power plant. The deal eventually saves hundreds of jobs in the depressed, remote region but also leaves the province of Ontario liable for as much as $247 million if an environmental ruling undermines the value of the power plant to its new owner, Ontario Hydro.

K-C threatened to downsize the mill, shutting down four of five machines and eliminating 1,200 of 1,600 jobs if the hydro station was not purchased. Even with the employee buyout, employment at the facility will fall to 800 by next year and to 670 by 1994. At Pine Falls, Abitibi-Price extended until late September an offer to sell the mill in hopes of reaching an agreement with a local management group headed by Ashok K. Narang, a former senior executive at Consolidated-Bathurst Inc.

Another instance of government aid to paper operations was New Brunswick's $60-million loan to Repap Enterprises Corp. Inc.'s Miramichi Pulp & Paper Inc. unit in Newcastle. The company noted the mill was a big contributor to the region as it sought to fund development of a new paper machine at the mill, which was undergoing a $1.2-billion capital expansion program. But it became apparent in 1991 that government help is no certain cure. In late September, the closure of Donohue Matane Inc.'s bleached chemithermomechanical pulp (BCTMP) mill in Matane, Que., became the second provincially backed operation to go belly up. The mill was a 50:50 joint venture of Donohue Inc. and Quebec's forestry agency Rexfor, which also held a 50% interest in the failed Cascades Inc. Port Cartier, Que., BCTMP mill that was permanently closed in late August.

The Port Cartier mill began production in 1988 amid high hopes that the new operation would bring renewed prosperity to the remote and economically depressed North Shore. The mill had previously been the site of ITT Rayonier Inc.'s troubled dissolving pulp mill. After ITT shut down the legendary white elephant in 1986, Cascades acquired the mill for $20 million and spent another $90 million to convert it to BCTMP production. Rexfor invested about $40 million in the project, which employed about 500 workers.

Mallette Inc. and Rexfor finalized a deal early in 1990 to form a joint venture to buy the assets of St-Raymond Paper Inc. The newsprint and groundwood facility had been closed by bankruptcy the year before as a result of rising pulp prices and plummeting newsprint tabs. About $125 million was to be spent on converting the mill to machine-finished coated publication paper.

Given the increasing amount of mill closures and ma-

MAJOR CANADIAN PAPER INDUSTRY ACQUISITIONS

Acquiring company	Assets purchased	Estimated value (million C$)	Year
Sonoco Products Co./Coretch Corp.	Paperboard Industries Corp.	n.a.	1991
Supremex Inc.	Abitibi-Price Inc., Innova Envelope unit	C$37	1991
Tembec Inc./Employee buyout	Spruce Falls Power & Paper Co.	n.a.	1991
Procter & Gamble Co.	Facelle Co. Ltd., tissue unit of Canadian Pacific Forest Products Ltd.	n.a.	1991
Slocan Forest Products Ltd.	Fibreco Pulp Inc. CTMP mill	n.a.	1991
Jefferson Smurfit Corp.	Sells 50% interest in Temboard & Co. L.P. to Tembec Inc.	n.a.	1991
Rock-Tenn Co.	Dominion Paperboard Products Ltd.	n.a.	1991
Standoff Co. Ltd. (Ireland)	Controlling shares of Lawson Mardon Group Ltd.	77	1991
Repap Enterprises Corp. Inc.	Sells 7% stake in Tembec Inc.	12.5	1990
Mallette Inc., Rexfor	Joint venture buys assets of St-Raymond Paper Inc.	n.a.	1990
Louisiana-Pacific Corp.	Increased stake in Doman Industries Ltd. to 14.7%	n.a.	1990
Stone-Container Corp.	Completed purchase of remaining CB Pak Inc. shares	47	1989
Mölnlycke AB	50% stake in Sancella Inc.	n.a.	1989
Stone Container Corp.	Consolidated-Bathurst Inc.	2,600	1989
Doman Industries Ltd.	Increased stake in Western Forest Products Ltd. to 56%	137	1989
Repap Enterprises Inc.	Manfor Ltd.	132	1989
Scott Paper Ltd.	E.B. Eddy Forest Products Ltd.'s White Swan Tissue Div.	110	1989
West Fraser Timber Co. Ltd.	50% stake in Alberta Newsprint Co. Ltd.	n.a.	1989
Maclaren Industries Inc.	41% stake in Normick Perron Inc.	120	1989
Olympia & York	Raised stake in Abitibi to about 84% as of Nov. 1, 1989	n.a.	1989
Canadian Pacific Ltd.	Merged Great Lakes Forest Products Ltd. with CIP Inc. to form Canadian Pacific Forest Products Ltd.	1,260	1988
Daishowa Paper Manufacturing Co.	Peace River, Alta., greenfield mill	500	1988
Daishowa Paper Manufacturing Co.	Reed International plc's North American Paper Group	650+	1988
Fletcher Challenge Ltd.	Raised stake in British Columbia Forest Products Ltd. to 67.4% and in Crown Forest to 100%; combined both under Fletcher Challenge Canada Ltd.	573	1988
Kinburn Industrial Corp.	Increased share in Paperboard Industries Corp. to 98% from 51.8%	72	1988
Olympia & York	Raised stake in Abitibi-Price Inc. to about 74.8% as of Jan. 11, 1988	n.a.	1988
Jefferson Smurfit Corp.	50% stake in Temboard & Co. Ltd.	30	1988
Abitibi-Price Inc.	Gulf Canada Ltd. spins off its 83% share of Abitibi-Price Inc., increasing the public float of Abitibi shares to 27%	n.a.	1987
Cascades Inc.	Acquires 32% of "Class B" voting stock and 28.7% of "Class A" nonvoting stock of Rolland Inc. in takeover attempt	4.5	1987
Domtar Inc.	Genstar Corp.'s gypsum wallboard operations	241 (US)	1987
Fletcher Challenge Ltd.	Acquires 47% of British Columbia Forest Products Ltd.	505	1987
Oji/Canfor	Howe Sound Pulp Div.	307.5	1987
Paperboard Industries Corp.	Acquires more than 95% of common shares and more than 92% of nonvoting shares of Belkin Inc.	219.5	1987
Quebecor Inc. and British Printing & Communication Corp.	Purchased 56% share of Donohue Inc. held by Quebec government	320	1987
St-Raymond Paper Inc.	Mill president purchases 60,000-tpy groundwood mill (Chute Panet) from Imperial Trust of Montreal	n.a.	1987
Timber Investments Ltd.	Acquires over 99% of outstanding shares of Balco Industries Ltd.	27	1987
Weldwood of Canada	St. Regis Paper Co. (Canada) from Champion	264	1987
Cascades Inc.	60-metric-tpd roofing felt mill at Joliette, Que., from Canadian Gypsum Co. Ltd.; paper machines at Nitec Paper Corp.'s Niagara Falls, N.Y., mill	n.a;, 1.75	1986
Consolidated-Bathurst, Power Corp. of Canada, China International Trust & Investment Corp.	Westar Timber Ltd.'s Castlegar, B.C., pulp mill	95	1986
Gordon Investment Corp. and Merrill Lynch Canada Inc.	26.3% stake in BCFP held by Brunswick Pulp & Paper Co. and 15.2% stake in BCFP held by Mead Corp.	n.a.	1986

Continued

chine shutdowns, Canadian paper companies were pretty much on the sidelines of the acquisition game in 1991. The downcycle instead brought some withdrawals from previously touted overseas investments, namely Abitibi-Price's cancellation of its role in new newsprint mills in Scotland and Venezuela. In March, Noranda Forest Inc. and paper machinery maker Hymac of Montreal, Que., canceled a planned joint-venture pulp mill project slated for the Soviet city of Gorky. Canada has undertaken efforts to assist People's Rep. China's efforts to modernize its pulp and paper industry through loans and equipment financing.

Foreign investment trend. In late 1987, it was apparent that foreign investment would become a trend in the Canadian pulp and paper industry. In December 1987, Oji Paper Co. Ltd. of Japan and Canfor Corp. formed a partnership to acquire Canfor's Howe Sound Pulp Div. at Port Mellon, B.C. The new company, Howe Sound Pulp & Paper Co. Ltd., started up a 200,000-metric-tpy newsprint machine in 1991, with Oji marketing the output. In February 1988, Daishowa Paper Manufacturing Co. committed to building

MAJOR CANADIAN PAPER INDUSTRY ACQUISITIONS (continued)

Acquiring company	Assets purchased	Estimated value (million C$)	Year
Paperboard Industries Corp.	Big M Paperboard's Palmyra, Mich., recycled board mill	C$1.145	1986
Repap Enterprises Corp. Inc.	Westar Timber Ltd.'s Prince Rupert, B.C., kraft market pulp mill	110	1986
Waferboard Corp.	Abitibi-Price Inc.'s Smooth Rock Falls, Ont., bleached kraft market pulp mill	45	1986
Weyerhaeuser Canada Ltd.	Prince Albert Pulp Co. Ltd.	248	1986
Canfor Corp.	25% share of International Pulp Co. Ltd. held by Feldmühle AG	n.a.	1985
Cascades Inc./Rexfor	ITT Rayonier's mothballed Port Cartier, Que., dissolving pulp mill; government financing approved in early 1986	17	1985 1985
CIP Inc.	50% of Tahsis Co. Ltd. not already owned	n.a.	1985
Gulf Canada Ltd.	90% of Abitibi-Price Inc. from Olympia & York in four installments; shares reduced to approximately 83.4% after Abitibi stock offering in April 1986	1,200	1985
Noranda Inc.	32% of Fraser Inc. not already owned	60	1985
Rauma-Repola Oy	25% of St. Marys Paper Co.	n.a.	1985
Repap Enterprises Corp. Inc.	Boise Cascade Canada Ltd.'s Newcastle, N.B., kraft market pulp mill	90 (US)	1985
St. Marys Paper Inc.	Sault Ste. Marie, Ont., mill of Abitibi-Price	n.a.	1984
Cascades Inc.	Jonquière, Que., mill of Abitibi	n.a.	1984
Bowater Inc.	Bowater Canadian Ltd., spun off from Bowater Corp.	57	1984
Kruger Inc.	Bowater Inc.'s Corner Brook, Nfld., mill	n.a.	1984
Cascades Inc.	Manville Corp. of U.S.'s 50% share of Papier Kingsey Falls mill; balance already held by Cascades	1.2	1984
Fraser Inc.	50% of Island Paper Mills at New Westminster, B.C.	25	1983
Fletcher Challenge Ltd.	96% of Crown Zellerbach Canada (since renamed Crown Forest Industries) mill at Campbell River, B.C.	242 (US)	1983
Western Pulp Limited Partnership	Western Forest Products' Port Alice and Squamish, B.C., mills	150	1983
James River Corp. (80%) and Buchanan Forest Products (20%)	Marathon, Ont., mill of American Can	10.5	1983
Cascades Inc.	East Angus, Que., mill of Domtar	n.a.	1983
Employees and outside investors	Bowater's Perkins Papers Ltd. mill at Candiac, Que.	n.a.	1983
Fletcher Challenge Ltd.	84% interest in Crown Zellerbach Canada Ltd.	242	1982
Noranda Mines Ltd.	49% of MacMillan Bloedel Ltd.	n.a.	1981
Brascan Ltd.	Raised stake in Noranda Mines Ltd. to 39% from 22%	1,100	1981
Olympia & York Developments Ltd.	Increased stake in Abitibi-Price Inc. to 88%	530	1981
Canadian Pacific Enterprises Ltd.	Canadian International Paper Co.	1,100	1981
Alberta Energy Co.	Noranda Mines Ltd.'s 28% stake in British Columbia Forest Products Ltd.	215	1981
Belkin Packaging Ltd.	Continental Group's two Canadian boxboard mills and three folding carton plants	60	1981
British Columbia Forest Products Ltd., Doman Industries Ltd., and Whonnock Industries Ltd.	Rayonier Canada, division of ITT Industries of Canada Ltd.	420	1980

n.a. = Not available.

a 340,000-tpy bleached kraft market pulp mill near Peace River, Alta. Despite environmental delays, the company started up the $550-million project in September 1990, with much of the output marketed in Japan. The Japanese made their biggest Canadian investment in mid-1988, when Daishowa announced it would buy Reed International plc's North American Paper Group for $565 million. This gave Daishowa a 432,000-tpy newsprint mill at Quebec City, Que., that also makes 35,000 tpy of boxboard and 20,000 tpy of sulfite pulp for market. The Reed acquisition made Daishowa one of the largest foreign investors in Canadian pulp and paper, with a 25% interest in Cariboo Pulp & Paper Co. and a 50% share in Quesnel River Pulp Co. But still looming over the industry is the 1989 blockbuster acquisition of Consolidated-Bathurst by Stone Container Corp. of the U.S., the last major move into the Canadian industry by an outside company.

Stone Container completed the $2.6-billion acquisition of Consolidated-Bathurst in March 1989 with the offer of $25/share for 100% of the outstanding shares—a 50% premium over the stock's price at that time. The merged operations also gave Stone the third-place position among North American newsprint producers and ranked it among the continent's top ten market pulp suppliers. The new Stone-Consolidated Inc. operations were kept separate and included Consolidated-Bathurst's overseas operations, giving Stone Container a much desired foothold in Europe.

Later in 1989, Stone-Consolidated completed a $46.5-million buyout of just over 4 million shares of CB Pak Inc. Stone already owned nearly 17 million shares, or about 80% of the firm's holdings. Stone-Consolidated reportedly meant to sell CB Pak's remaining assets and liquidate the firm, which was expected to bring in about $200 million.

But Stone Container found itself in something of a bind the following year. The U.S. firm had taken on $12.6 billion in senior long-term debt, in part to fund the Consolidated-Bathurst purchase. Although Stone had made interest payments easily, the company announced in mid-1990 that banks would be willing to lend it $400 million to help it through an earnings downturn and to repay debt coming due in September. Unfortunately for Stone Container, newsprint markets soon began to wilt, and the company was hard pressed to operate its new mills profitably.

Another U.S. investment in Canada occurred in late 1988, when Tembec sold to Jefferson Smurfit Corp. a 50% stake in its new 140,000-metric-tpy bleached paperboard mill at Temiscaming, Que. Smurfit paid about $30 million for an undisclosed number of partnership units in Temboard & Co. Ltd. Partnership, the entity formed to build and finance the new mill. In July 1991, Procter & Gamble Co. bought the Facelle Co. Ltd. tissue operations of Canadian Pacific Forest Products Ltd., making P&G the second largest tissue producer in Canada behind Scott Paper Ltd.

Canadian investments. While foreign investors made their mark on the Canadian pulp and paper industry, acquisition activity within the country was also on the rise. Early in 1988, Weldwood of Canada Ltd. bought St. Regis Paper Co. (Canada) Ltd. from Champion International Corp., giving Weldwood control of the 182,000-tpy bleached softwood kraft market pulp mill at Hinton, Alta. At about the same time, Olympia & York announced that it had acquired another 1.5 million common shares of Abitibi-Price, raising its stake to about 74.8% of the company's common shares. Its stake had increased to 84% by October 1989. In 1991, Slocan Forest Products Ltd. completed the acquisition of Fibreco Pulp Inc., which holds an 80% stake in a softwood pulp mill in Taylor, B.C. This move marked Slocan's official entry into the pulp industry. Probably the biggest ownership upheaval within the Canadian industry itself was the 1988 merger of Great Lakes Forest Products Ltd. with CIP Inc., creating the second largest North American producer of pulp and newsprint out of two Canadian Pacific Ltd. subsidiaries. The new company, Canadian Pacific Forest Products, was created in a deal valued at $1.26 billion.

As the U.S. continues to gain a competitive edge against Canadian newsprint manufacturers, companies have begun to invest in American operations, such as Abitibi-Price's 50%-owned Alabama River Newsprint Co. mill in Claiborne, Ala., which started up in July 1990. The company also has a 50% stake in Augusta Newsprint Co. in Georgia, where it planned to install a deinking line. Canadian Pacific Forest Products has a 40% interest in Lake Superior Forest Products Inc.'s newsprint mill in Usk, Wash. Five publisher partners and CP Forest went to court in 1991 over the company's refusal to rescind a newsprint price increase that went into effect Jan. 1. MacMillan Bloedel Ltd. operates a linerboard and corrugating medium mill in Pine Hill, Ala., and in 1991 announced a partnership with Haindl Papier of Germany to build a recycled newsprint mill in California.

Cyclical consolidation. Ever since the late 1970s, merger and acquisition activity in the Canadian pulp and paper industry has been largely cyclical, responding to the ups and downs of the general economic climate. For example, the years 1978-81 were hectic, with the most significant events during that period being the takeovers of Canada's two largest pulp and paper companies—MacMillan Bloedel and Abitibi-Price—by outside interests.

The pendulum swung in the opposite direction as the recession of 1982 halted takeover activity. During the following two years, only three major ownership changes took place: Crown Zellerbach Corp. sold its Canadian operations to Fletcher Challenge Ltd. of New Zealand, Western Forest Products Ltd. sold its two British Columbian pulp mills to a limited partnership group, and Bowater Corp. of the U.K. spun off its North American assets into Bowater Inc.

The pattern of smaller, more select purchases continued in 1985. Still not fully recovered from the overexpansion of the early 1980s, companies were cautious in their spending plans. Canfor, CIP, and Noranda Inc. all consolidated their holdings in 1985 by purchasing the remaining assets of companies in which they already held majority stakes.

The level of acquisition activity in 1986 did not increase from that of the previous year, although the deals themselves were increasingly newsworthy. As the year progressed, the level of activity accelerated, with many deals reaching conclusions in 1987. In a joint venture of international scope announced in June 1986, a partnership was formed by Consolidated-Bathurst, Power Corp. of Canada, and China International Trust & Investment Corp. (the investment agency of People's Rep. China) to purchase Westar Timber Ltd.'s Castlegar, B.C., kraft market pulp mill. The deal was the first major investment made by CITIC, giving it a 50% share in the mill. The two Canadian companies each acquired 25% shares.

The biggest deals during first-half 1987, in terms of both money and publicity, were the sales of Donohue and British Columbia Forest Products. In fall 1986, the Quebec government offered for sale its shares of both Donohue and Domtar Inc., drawing interest from a variety of sources. A deal was finally struck in February 1987, when an offer for the Donohue shares, tendered by Quebecor Inc. and Maxwell Communications Inc. (formerly British Printing & Communication Corp.), was accepted. A $320-million deal for 55.25% of Donohue was completed in July.

Also in February 1987, Fletcher Challenge of New Zealand made an offer for a 42% interest in BCFP, acquired the previous year by Gordon Investment Corp. and Merrill Lynch Canada Ltd. Fletcher Challenge eventually increased its holdings to 67.4% by 1988 while simultaneously completing its buyout of Crown Forest Industries Ltd. Together, the two acquisitions gave Fletcher Challenge a substantial interest in the Canadian industry, with assets estimated at over $2 billion. The following year, Fletcher Challenge merged the management groups of Crown Forest and BCFP under a new company called Fletcher Challenge Canada Ltd. Although Fletcher Challenge owned 100% of Crown Forest, it held only a 69% stake in BCFP and had no intention of raising its stake in the near term. The merger allowed Fletcher Challenge to control both operations, take advantage of synergies and cost savings, and spend its acquisition dollars elsewhere.

In January 1989, West Fraser Timber Co. Ltd. entered the paper business by acquiring a 50% interest in Alberta Newsprint Co. Ltd., a joint-venture firm that finished building a 220,000-tpy greenfield newsprint mill at Whitecourt, Alta., in 1990. Scott Paper Ltd., the Canadian affiliate of Scott Paper Co., reached an agreement in 1989 to buy E.B. Eddy Forest Products Ltd.'s White Swan Tissue Div. at Hull, Que., for approximately $110 million. This marked Eddy's exit from the tissue business. In second-half 1989, Scott Paper Ltd. decided to sell its 50% stake in Sancella Inc. to its joint-venture partner, Mölnlycke AB of Sweden, for an undisclosed amount.

Louisiana-Pacific Corp. launched a friendly takeover bid in 1988 for Doman Industries Ltd., which held a stake in Western Forest Products (possibly L-P's ultimate target). But L-P abandoned the attempt a month later. Then in the last quarter of 1989, Doman increased its stake in Western

FOREIGN OWNERSHIP OF CANADIAN PULP AND PAPER COMPANIES

Company	% owned	Foreign owner	Assets
Alberta Newsprint Co. Ltd.	50%	West Fraser Timber Co. Ltd. , U.S.	Newsprint mill, Whitecourt, Alta.
Alberta-Pacific	35	Mistubishi (25% Kanzaki), Japan	Proposed Athabasca, Alta., pulp mill
Beaver Wood Fibre Co.	100	Georgia-Pacific Corp., U.S.	Paperboard mill, Thorold, Ont.
Boise Cascade Canada Ltd.	100	Boise Cascade Corp., U.S.	Pulp/paper mills, Fort Francis and Kenora, Ont.
Bowater Mersey Paper Co. Ltd.	49	Washington Post Co., U.S.	Pulp/newsprint mill, Liverpool, N.S.
	51	Bowater Inc., U.S.	
Cariboo Pulp & Paper Co.	50	Champion International Corp.[1], U.S.	Market pulp mill, Quesnel, B.C.
	50	Daishowa Marubeni International, Japan	
Celgar Pulp Co.	50	CITIC B.C., People's Rep. China	Market pulp mill, Castlegar, B.C.
	25	Stone-Container Corp., U.S.	
Crestbrook Forest Industries Ltd.	32	Honshu Paper, Japan	Market pulp mill, Skookumchuck, B.C.
	32	Mitsubishi Paper Mills Ltd., Japan	
Daishowa Canada Co.	100	Daishowa Paper Manufacturing, Japan	Peace River, Alta., pulp mill
Daishowa Forest Products Ltd.	100	Daishowa Paper Manufacturing, Japan	Quebec City, Que., newsprint mill
Doman Industries Ltd.	15	Louisiana-Pacific Corp., U.S.	B.C.-based wood products and pulp
Donohue Inc.	27	Maxwell Communications Inc.[2], U.K.	One pulp/paper mill, plus holdings
Donohue-Malbaie	49	New York Times Co., U.S.	One machine, Clermont, Que.
Eurocan Pulp & Paper Co.	50	Enso Forest Products, Enso-Gutzeit, Finland	Pulp/paper/board mill, Kitimat, B.C.
	50	West Fraser Timber Co. Ltd., U.S.	
Fletcher Challenge Canada Ltd.	72	Fletcher Challenge Ltd., New Zealand	Pulp/paper mills in B.C. and U.S.
Gaspesia Pulp & Paper Co. Ltd.	49	New York Times Co., U.S.	Pulp/newsprint mill, Chandler, Que.
Glassine Canada Inc.	100	Simkins Industries Inc., U.S.	Paper mill, Quebec City, Que.
Gold River Newsprint L.P.	22	Nine partners in U.S.. U.K, Japan, Singapore	Newsprint mill in Gold River, B.C.
Howe Sound Pulp & Paper Ltd.[3]	50	Oji Paper Co., Japan	Joint venture with Canfor Corp.
James River-Marathon Ltd.	80	James River Corp., U.S.	Market pulp mill, Marathon, Ont.
Kimberly-Clark of Canada Ltd.	100	Kimberly-Clark Corp., U.S.	Four pulp or paper mills, Ontario

Continued

Forest Products to 56%. The $137-million deal included an option to buy the remaining 44% interest held by Toronto-Dominion Bank and Royal Bank of Canada. L-P then hiked its share in Doman to 14.7% in mid-1990, fueling rumors that it might make a second run at the company. The 14.7% shareholding falls short of the 20% level deemed to be a controlling interest under Canadian securities law. If L-P did eventually manage to acquire a controlling interest in the Canadian firm, it would benefit from Doman's access to British Columbian forestland and sawmill byproducts.

FOREIGN OWNERSHIP OF CANADIAN PULP AND PAPER COMPANIES (continued)

Company	% owned	Foreign owner	Assets
NBIP Forest Products Inc.	25%	Oji Paper Co. (8%, Mitsui), Japan	Pulp/newsprint mill, Dalhousie, N.B.
Northwood Pulp & Timber Ltd.	50	Mead Corp., U.S.	Market pulp mill, Prince George, B.C.
Procter & Gamble Cellulose Ltd.	100	Procter & Gamble Co., U.S.	Market pulp mill, Grande Prairie, Alta.
Quebec & Ontario Paper Co.	100	Tribune Co., U.S.	Pulp/newsprint mills, Baie Comeau, Que.; Thorold, Ont.
Quesnel River Pulp Co.	50	Daishowa Paper Manufacturing, Japan	Market pulp mill, Quesnel River, B.C.
	50	West Fraser Timber Co. Ltd., U.S.[4]	
St. Anne Nackawic Pulp & Paper	100	Parsons & Whittemore Inc., U.S.	Market pulp mill, Nackawic, N.B.
St. Marys Paper Inc.	25	Rauma-Repola, Finland	Pulp/paper mill, Sault Ste. Marie, Ont.
Scott Paper Ltd.	50	Scott Paper Co., U.S.	Pulp/paper mills in B.C., Quebec
Scott Maritimes Ltd.	100	Scott Paper Co., U.S.	Market pulp mill, Abercrombie Point, N.S.
Slave Lake Pulp Corp.	25	Mo och Domsjo, Sweden	Pulp mill, Slave Lake, Alta.
Sonoco Ltd.	100	Sonoco Products Co., U.S.	Paperboard mills, Brampton, Ont., Terrebonne, Que.
F.F. Soucy Inc.	100	Brant-Allen Industries, U.S.	Pulp/newsprint, Rivière-du-Loup, Que.
F.F. Soucy Inc. et Associés	50	Brant-Allen Industries, U.S.	Paper mill, Rivière-du-Loup, Que.
	40	Dow Jones, U.S.	
Stone-Consolidated Inc.	100	Stone Container Corp., U.S.	Eight mills in eastern Canada
Stora Forest Industries Ltd.	100	Stora Kopparbergs, Sweden	Pulp/newsprint mill, Port Hawkesbury, N.S.
Temboard & Co. Inc.	50	Jefferson Smurfit Corp., U.S.	Bleached board mill, Temiscaming, Que.
Weldwood of Canada Ltd.[5]	85	Champion International Corp., U.S.	Market pulp mill, Hinton, Alta.
Weyerhaeuser Canada Ltd.	100	Weyerhaeuser Paper Co., U.S.	Market pulp mills, Kamloops, B.C.; Prince Albert, Sask.

1. Through Weldwood of Canada Ltd.
2. Mircor Inc. was set up to buy 55.25% of Donohue stock from Dofor (a government body). British Printing owns 49% and Quebecor owns 51% of Mircor.
3. Proposed venture combining existing Howe Sound Pulp Div. and Oji investment in newsprint mill.
4. West Fraser Timber Co. Ltd. is majority-owned by Ketcham family of U.S.
5. Weldwood acquired 100% of Champion Forest Products (Alberta) Ltd.'s mill at Hinton, Alta., early in 1988, at which time Champion's interest in Weldwood increased from 71.8% to 84.6%.

Canada:

LABOR

Labor remains a well-organized, highly unpredictable factor in the Canadian pulp and paper industry, with workers able to affect their status by idling significant portions of the industry at the same time. This was evident in a season of strikes and disruptions in eastern Canada in 1990 as workers opposed what they saw as contract concessions. And in September 1991, after almost six months of bargaining, unions and employers in British Columbia extended by ten months the agreement that had expired in April, avoiding an almost-certain strike by the province's 17,000 pulp and paper workers. However, Canadian unions are being hampered not only by automation but also by increasing numbers of mill closures and permanent and temporary machine shutdowns as the industry struggles to deal with the full-blown recession that hit the country in late 1990.

According to Statistics Canada, direct employment in the Canadian paper and allied industries segment increased to 145,000 in 1989 from 132,000 in 1988. The 1989 employment figure is equal to that of 1981, before the last economic recession that devastated the forest products industry in Canada. Employment dipped to 111,000 in 1986 but has since climbed significantly. Preliminary figures show, however, that total employment in the segment will drop in 1990 to 131,000 as layoffs and shutdowns mount across the country. Pulp and paper mills employed 81,058 workers in 1988, Statistics Canada reported, the highest level since 1982. While employment increased 0.9% from 1986 to 1987 and again from 1987 to 1988, salaries rose 3.8% from 1986 to 1987 and 7.0%, to C$3.3 billion, in 1988. Forest products companies in Canada consistently bemoan their high labor costs as being a major hindrance to international competitiveness.

The largest labor union in the Canadian pulp and paper industry is the Canadian Paperworkers Union (CPU), which had about 60,000 members in 1991. CPU is a member of the national Canadian Labour Congress. Also, about 14,000

CANADIAN PAPER INDUSTRY WORKERS' UNIONS

Union	Region represented	Number of members	Number in primary pulp and paper
Canadian Paperworkers Union (CPU)	Canada	60,000	—
	Maritimes	—	—
	Quebec	—	—
	Ontario and Manitoba	—	—
	Saskatchewan, Alberta, and British Columbia	—	—
Le Fédération des travailleurs du papier et de la fôret (FTPF-CNTU)	Quebec	13,000	5,700
Pulp & Paper Workers of Canada (PPWC)	Western Canada	7,300	5,300
United Paperworkers International Union (UPIU)	Ontario and Manitoba	1,700	1,700

Note: Pulp and paper workers are also represented in Canada by such major unions as the International Assn. of Machinists & Aerospace Workers and the International Brotherhood of Electrical Workers.

Quebec paper industry workers are represented by La Fédération des travailleurs du Papier et de le fôret (FTPF [Federation of Paper and Forestry Workers]), a French-Canadian union affiliated with the Confederation of National Trade Unions (CNTU). Another major Canadian union that plays a significant role in British Columbian negotiations is the Pulp & Paper Workers of Canada (PPWC), with about 7,300 members. The United Paperworkers International Union (UPIU), with the vast majority of its membership in the U.S., represents about 1,700 workers in Ontario and Manitoba. CPU broke off from UPIU in 1974.

CPU is headed by Don Holder, who was reelected in September 1991 despite some dissension within the ranks of the union. PPWC is led by Stan Shewaga, who was reelected in March 1991. CPU members elect their president through a conference attended by elected delegates, while PPWC holds an election involving all members directly. FTPF is headed by Claude Plamondon. The union holds elections every two years and was to hold its next annual meeting in November 1991.

The contract bargaining focus in Canada usually alternates between the East and the West. In eastern Canada, CPU traditionally targets a major company with which to work out a "pattern" contract and then uses it as a model in negotiations with other companies bargaining that year. On the West Coast, most pulp and paper companies belong to an industry-wide bargaining group called the Pulp & Paper Industrial Relations Bureau. CPU and PPWC bargain jointly in British Columbia, while the province's woodworkers negotiate through Forest Industrial Relations Ltd. In eastern Canada, the industry does not bargain collectively, except for four mills in Quebec, a consortium known as the Eastern Canadian Newsprint Group. Box converting workers in Canada do bargain collectively, establishing a model contract with one of the industry's major employers.

Unions in the Canadian pulp and paper industry tend to wield more bargaining power than their U.S. counterparts because of a highly centralized bargaining pattern. Unions also benefit from certain prolabor government policies, such as those prohibiting companies from operating mills during walkouts. Quebec's antiscab laws are noted to be the most restrictive. However, recent labor settlements indicate that the Canadian industry, in the wake of weak markets, is more willing to take downtime rather than agree to costly contracts. Nonetheless, Canadian unions have proved capable of staging prolonged and damaging strikes, ranging from several weeks to several months, in order to attain their demands. In 1990, CPU members struck seven Abitibi-Price Inc. mills for one month, while strikes at three Canadian Pacific Forest Products Ltd. mills lasted almost three months. Strikes at Quebec & Ontario Paper Co. in Thorold, Ont., went on for four months, and a strike at Rothesay Paper Ltd. dragged on from April 1990 to February 1991. In 1981, a six-week strike by the entire British Columbian forest products industry cost companies an estimated $18 million/day in sales revenue, with employees losing in excess of $8 million/day in earnings. Western workers struck again in 1984 for 12 weeks.

CANADIAN PULP AND PAPER EMPLOYMENT AND EARNINGS

Year	Number of mills	Employees	Salaries/ wages	% change Employees	% change Salaries/ wages
1988	144	81,058	C$3,331,900	0.9%	6.9%
1987	144	80,334	3,114,000	1.0	3.8
1986	142	79,570	2,999,232	2.6	6.7
1985	137	77,562	2,810,801	-2.3	6.5
1984	142	79,404	2,638,805	0.3	4.3
1983	137	79,164	2,528,354	-4.7	3.5
1982	143	83,104	2,442,126	-5.4	5.7
1981	144	87,882	2,309,802	1.2	12.7
1980	144	86,872	2,049,743	-0.2	11.0
1979	146	87,051	1,847,128	1.7	8.9
1978	144	85,601	1,696,769	1.3	10.1
1977	144	84,533	1,541,355	-2.8	8.9
1976	147	86,995	1,415,844	3.5	29.7
1975	147	84,046	1,091,676	-2.5	-0.5
1974		86,203	1,097,098	7.6	24.1
1973		80,085	884,242	1.4	9.3
1972		78,969	808,869	-0.5	8.5
1971		79,397	745,608	-1.2	6.3
1970		80,371	701,395		
Average					
1981-84				-2.2	6.6
1976-80				0.7	13.7
1971-75				1.5	10.3

Source: Statistics Canada.

The agreement reached in British Columbia in 1988 marked the second consecutive contract the western industry had reached without any major disruptions. But in 1991, both sides approached negotiations hardened in their positions, and a massive strike was narrowly avoided in September when the contract was extended to April 1992. The 19 mills involved in the negotiations represent about half of Canada's total market pulp capacity and about 19% of total Canadian newsprint capacity. The contract postponement impacted markets immediately as customers began to work down inventories built up in anticipation of another labor disruption.

Unrest in the West. Negotiations will resume perhaps as early as March 1992 between CPU and PPWC and 14 pulp and paper companies in British Columbia, with both sides deadlocked over the industry's demand to operate on all statutory holidays and bring down costs across the board. With the prospects of a hardened management position, an absolute willingness on the part of the mills to curtail production, and the economic recession that had engulfed the country, labor opted to accept a wage freeze in the hope that the scenario would improve by spring.

By a 59% acceptance vote in September, workers gave management the year without cost increases that it demanded, but observers criticized the industry's failure to direct fundamental change in British Columbia's labor structure when it appeared to wield the upper hand. With woodchip, pulp, and newsprint stockpiles at record levels, producers as well as customers expected a disruption, even a drawn-out strike, to provide much-needed downtime. The unions, who originally demanded a 12% wage hike in a one-year contract, may have strengthened their position by meeting the industry's wage freeze demand and avoiding concessions in other areas, such as job descriptions and holidays. But both sides may find themselves in spring 1992 with an economic atmosphere equal to or even worse than that in summer 1990. The British Columbian wage freeze in 1991 was the first time since the early 1970s that the base wage rate for eastern Canadian workers ($17.11/hour) surpassed that for western workers ($17.07/hour).

While negotiations dragged on through the summer, Celgar Pulp Co. locked out 300 PPWC members at the company's mill in Castlegar, B.C., for 18 days in a dispute related to a damage claim against the union. The lockout disrupted an expansion project to double the mill's capacity and removed about 9,900 metric tons of pulp from the market.

In a move to put itself in a stronger position for strikes that seem almost inevitable, CPU in September voted to more than double its strike pay to $200/week. Delegates at the union's annual conference in Vancouver, B.C., voted to boost their strike pay from $80 and to increase their union dues to build CPU's defense fund. The fund totaled about $8 million in late 1991, and it would cost CPU about $1.4 million/week to pay the new level of benefits if a strike occurred in British Columbia.

Turmoil in the East. The made-in-Canada recession that got under way in 1990 created a year of mill layoffs and shutdowns in 1991, affecting scores of forest industry workers. Another significant development was several instances of paper companies opting to sell mills to their employees as they tried to scale back operations but being unable to find many willing buyers. After almost five months of roller coaster negotiations, Kimberly-Clark Corp. and the New York Times Co. finalized a deal to give Spruce Falls Power & Paper Co. Ltd. in Kapuscasing, Ont., to the mill's workers, while the Ontario government pledged to buy the mill's power plant for $140 million. Despite the success, the mill will lose half of its work force by 1994.

In Ontario (Spruce Falls), Quebec (Donohue Matane Inc.), and New Brunswick (Repap Enterprises Corp. Inc.), provincial governments took active roles in propping up jeopardized mills in costly efforts to retain desperately needed jobs in remote regions. Abitibi-Price undertook an effort to sell its Pine Falls, Man., newsprint mill to employees and also arranged an acceptable termination package for 420 workers at its Thunder Bay Div. newsprint mill in Ontario, which it shut down in April 1991.

The image of unions reeling from layoffs contrasts with the muscle flexing displayed in 1990 as workers struck at 16 separate mills in eastern Canada, taking more than 675,000 metric tons of newsprint capacity off the market. The disruption allowed newsprint producers to institute a $35/ton price hike in June 1990, but another attempt in January 1991 failed to hold.

With the industry already reeling from poor markets and the makings of a recession, contracts expired Apr. 30, 1990, for almost 30,000 paper industry workers in the eastern provinces. In a move that symbolized Canadian labor's concern about free-trade influences on wages, CPU targeted U.S.-owned Stone-Consolidated Inc. to establish a pattern contract. The two sides hammered out a compromise contract that provided an attractive pay hike and vacation

CANADIAN PAPER WORKER STRIKES, 1990

Company	Mill	Number of workers	Dates of strikes
James Maclaren Industries Inc.	Buckingham, Que.	420	7/26-8/27
Quebec & Ontario Paper Co.	Baie Comeau, Que.	1,200	7/28-8/27
	Thorold, Ont.	530	8/14-12/18
Abitibi-Price Inc.	Thunder Bay Div.[1]	515	9/10-10/9
	Fort William Div.[1]	—	9/10-10/9
	Provincial Papers[1]	750	9/10-10/9
	Iroquois Falls, Ont.	690	9/10-10/9
	Chandler, Que.	530	9/10-10/9
	Stephenville, Nfld.	260	9/10-10/9
	Grand Falls, Nfld.	740	9/10-10/9
Canadian Pacific Forest Products Ltd.	Gatineau, Que.	1,255	9/12-1/2/91
	Dalhousie, N.B.	835	9/12-1/2/91
	Thunder Bay, Ont.	1,760	10/11-1/2/91
Repap Enterprises Corp. Inc.	Newcastle, N.B.	850	11/24-11/30
Irving Tissue Co.[2]	St. John, N.B.	105	3/29-5/25
Rothesay Paper Ltd.[2,3]	St. John, N.B.	450	4/9-2/24/91

1. Located in Thunder Bay, Ont.
2. Owned by Irving Pulp & Paper Ltd. Strikes not related to Canadian Paperworkers Union pattern negotiations.
3. Company operated one of two newsprint machines during strike.

pay raise for workers but also allowed the company flexibility with job descriptions and the ability to operate its mills on two statutory holidays. Although the contract was an achievement for both sides, the pattern settlement ran into trouble as the provisions in the contract that allowed flexibility and holiday run-throughs were considered local issues, and CPU leadership pledged its support to locals that opposed those concessions. Strikes occurred at Quebec & Ontario Paper and James Maclaren Industries Inc., as workers were disenchanted by the lack of gains in job security and cost-of-living language. Negotiations at Abitibi-Price faltered, and on Sept. 10, about 4,000 union workers struck seven of the company's nine locations. Strikes also occurred in September at Canadian Pacific Forest Products mills, and by late September, about 23% of Canada's newsprint capacity was shut down in strikes at 11 facilities.

The summer bargaining quickly became fall negotiations and were finally settled in winter. The strike at Abitibi's seven mills ended Oct. 9, when the company backtracked on the two most contentious issues; but two days later, while observers expected the Abitibi breakthrough to bring progress to the other strikes, over 1,700 workers shut down CP Forest's massive Thunder Bay, Ont., newsprint and pulp operation.

Identical to the Stone pattern agreement, the Abitibi contract called for a pay hike of 85¢ in the first year and 5.5% in each of the next years, lifting wages 16.5% by 1992, an average take-home pay increase of $11,000. Vacation pay was lifted to 2.4% annually, a 20% improvement, and workers granted the company increased flexibility in assigning work to maintenance employees and tradesmen. But unlike the pattern deal with Stone-Consolidated, Abitibi would need the permission of its union locals to operate its mills on statutory holidays, and the union won job security language designed to protect workers in the event of machine and mill shutdowns that could lead to the loss of jobs. The last of the eastern strikes was settled in January 1991 when workers returned to work at CP Forest's mills.

CANADIAN BASE-WAGE RATES 1970-91

(C$/hour)

Year	Eastern Canada	Western Canada
1991	C$17.11	C$17.07
1990	16.22	17.07
1989	15.37	16.17
1988	14.71	15.33
1987	14.26	14.48
1986	14.01	14.09
1985	13.34	14.09
1984	12.83	13.48
1983	12.52	12.96
1982	11.38	12.96
1981	10.16	11.46
1980	9.23	9.96
1979	7.89	9.06
1978	7.46	8.16
1977	6.99	7.61
1976	6.47	6.89
1975	5.88	6.14
1974	4.57	5.10
1973	4.21	4.45
1972	3.85	4.09
1971	3.51	3.80
1970	3.25	3.50

Sources: *Pulp & Paper Week*, Canadian Paperworkers Union.

Canada:

TIMBER RESOURCES AND PULPWOOD CONSUMPTION

Canadian forests account for roughly 10% of the world's forestland, according to the Canadian Institute of Forestry. They hold 18% of the world's softwoods and 3% of the world's hardwoods, the Canadian Pulp & Paper Assn. reported. They contain 24 billion m³ of timber, three-quarters of which is softwood. The principal forest species include spruce, pine, balsam fir, and aspen/poplar.

Nearly half of Canada's 1 billion hectares (ha) of land is forested, and almost 250 million ha are considered to be productive forests. Nine million ha of those forests are set aside for parks and other purposes, and roughly half of the remainder is considered commercially viable.

About 1 million ha are harvested each year, mostly by clear-cutting. The harvest yields roughly 170 million m³ of timber vs an annual allowable cut (AAC) of 240 million m³. Every five years, tree farm licensees calculate an AAC for their areas, to be approved by the Ministry of Forests. Over the following five-year period, the total harvest must fall within 10% of the AAC estimate, or a penalty could result. But on an annual basis, the harvest can swing by as much as 50%, allowing flexibility in the event of strikes or changing market and weather conditions.

Harvest rates of softwood are high compared with the AAC, and plans are in place to increase softwood growth rates. On the other hand, CPPA noted that the industry has not taken full advantage of hardwood reserves; much new pulp and paper capacity being planned by the industry will take advantage of this alternate fiber supply.

Of the million ha harvested each year, Canada's Forest Inventory 1986 showed 315,000 ha were in Quebec, 244,000 ha in British Columbia, and 237,000 in Ontario. Among the provinces, trees in British Columbia show the most rapid growth, 4.9 m³/ha/year.

Provincial governments own 80% of Canada's productive forestland, the federal government owns 11%, and the remainder is in private hands. The provincial governments have traditionally managed the forests that were leased and harvested by the private sector, but they are transferring more of the regeneration and management duties to private companies. In British Columbia, for example, harvesters are now required to replant any land they cut over.

Still, the federal and provincial governments spend millions on fostering the forests. For instance, a preliminary Forest Resource Development Agreement (FRDA) was announced for British Columbia early in 1991. The agreement would provide C$200 million for forest management over

CANADIAN PULPWOOD CONSUMPTION

(000 m³)

Year	Roundwood	Total wood residue	Total wood
1989	47,688	56,655	104,343
1988	46,805	56,272	103,077
1987	45,539	56,431	101,970
1986	45,483	46,664	92,147
1985	44,115	45,180	89,295
1984	42,597	44,204	86,801
1983	39,755	43,353	83,108
1982	38,926	37,015	75,941
1981	44,717	39,669	84,386
1980	44,462	41,674	86,136
1979	44,910	41,054	85,964
1978	43,824	37,590	81,414
1977	42,042	33,913	75,955
1976	42,056	34,840	76,896
1975	39,503	24,056	63,559
1974	50,858	30,301	81,159
1973	47,795	27,986	75,781
1972	46,516	23,891	70,407
1971	45,245	20,968	66,213
1970	48,339	17,387	65,726

Source: Statistics Canada.

four years, with half the funds provided by the federal government and half by the province. The previous five-year, $300-million FRDA expired the previous March.

The new FRDA will be part of a five-year, $1.4-billion Forest Renewal Program, which will add $500 million in new funds to the moneys the British Columbian government had already allotted to reforestation. The fund will be split fairly evenly over the five years, providing roughly $280 million/year beginning with the 1991-92 spending year; this amount compares with $222 million for 1990-91.

The goal of the province's forest management plan is shifting away from the replanting of "not satisfactorily restocked" lands, which should be two-thirds finished within five years and completed by the end of the decade. British Columbian Forests Minister Claude Richmond said, "We're going to finish the big replanting job and refocus our efforts onto managing the new forests to produce quality trees and a more diverse forest environment." Those efforts will include spacing, fertilizing, and pruning second growth as well as research to maintain biological diversity in the forests. And auditing of replanting success will be increased from 100 harvest areas to 4,000.

Canada's timber volume rose 0.3%/year from 1976 to 1986 as a result of tree growth in standing forests, according to a study released in mid-1991 by federal Forestry Minister Frank Oberle. He added that industry is planting two seedlings for each tree it cuts down. Harvesting obviously affects timber supply, but nature itself has proved tremendously destructive to the forest, with fire, insects, and disease resulting in the loss of nearly as much timber as is harvested, the report said. When the results of harvesting and natural forces were combined, it was found that only 80% of the forest was regenerated in 1988, although that figure was up from 64% in 1976.

Forestry Canada's study indicated that in the medium term (30 to 60 years), there are "adequate levels of timber supplies to support the current level of industrial activity." However, it warned, "In the long term, Canada's timber supply prospects are less clear." The study noted regional shortages of particular types of wood and also stated that softwood harvesting is approaching a maximum level, although there is a surplus of hardwoods. Better protection from fire and pests could be the fastest way to maintain or expand the timber supply, the report advised.

Adam Zimmerman, chairman of Noranda Forest Inc., noted in a *Globe & Mail* editorial that 70% of the nation's annual harvest goes into building products and the remainder yields about 24 million tons of pulp and paper products. Forestry Canada reported that chips and residue provided one-fourth of the fiber required in the pulp and paper industry in 1970 but accounted for almost 60% in 1990, with the remainder from whole logs.

Market forces. Profits in Canada's lumber industry have been dropping since 1987, according to Forestry Canada. A number of forces are behind the industry's continued weakness. Most Canadian exports are sold in U.S. dollars, and the strength of the Canadian dollar relative to U.S. currency reduced returns for Canadian producers in 1990 and on into 1991.

Weak housing markets in Canada and the U.S. compounded the problem. U.S. housing starts plunged from 1.37 million units in 1989 to 1.19 million in 1990, while Canadian starts dropped from 215,000 to 182,000, their

PULPWOOD RECEIPTS FROM ALL SOURCES

(000 m^3)

Province	1990	1989	1988
Nova Scotia, New Brunswick	9,770	11,554	9,899
Quebec	11,020	13,290	12,621
Ontario	11,039	11,877	12,110
Alberta	2,136	1,767	1,773
British Columbia	3,926	5,242	6,145
Other	4,186	3,958	4,264
Total	42,076	47,688	46,812

Source: Statistics Canada.

RECEIPTS OF WOOD RESIDUE

(000 m^3)

Province	1990	1989	1988
Nova Scotia, New Brunswick	3,713	3,483	2,758
Quebec	16,719	17,131	15,249
Ontario	5,604	5,955	5,485
Alberta	2,582	2,286	1,928
British Columbia	26,239	27,137	25,503
Other	579	663	606
Total	55,436	56,655	51,527

Source: Statistics Canada.

CONSUMPTION OF ROUNDWOOD AND WOOD RESIDUE

(000 m^3)

Province	1990	1989	1988
Nova Scotia, New Brunswick	13,660	14,613	12,233
Quebec	27,596	28,887	28,860
Ontario	16,284	17,636	17,505
Alberta	4,818	3,933	3,645
British Columbia	30,159	32,160	33,281
Other	4,698	4,855	4,820
Total	97,215	102,084	100,343

Source: Statistics Canada.

lowest level since 1985 (in mid-1991 Canada lowered its projection for 1991 housing starts in the domestic market to 147,000 because the first quarter was slow). Lumber demand fell off significantly, leading to oversupply in the market. High interest rates also squeezed lumber companies' earnings and discouraged building.

To make matters worse, widespread downtime among Canadian market pulp producers—taken in an attempt to support pulp prices and limit inventory buildup—cut back on chip consumption. And log costs rose because of higher fees for logging on Crown land, the elimination of road-building credits, and timber companies' new responsibility for reforestation costs (taken over from the government). In British Columbia, stumpage fees are based on the provincial government's target for revenue from the lease holders and are tied to the value of the timber sold and harvested in these holdings.

These increased costs resulted from a 1986 agreement between Canada and the U.S. known as the Memorandum of Understanding (MOU), which placed a 15% federal export charge on Canadian softwood lumber entering the U.S. (otherwise the U.S. would have slapped import duty on the lumber). A year later, the two countries agreed that the federal charge could be replaced to some extent with provincial measures, such as increased stumpage fees and industry responsibility for reforestation. The agreement, combined with the strong Canadian dollar and high Canadian interest rates, reportedly helped push down Canada's share in the U.S. lumber market from 33.2% when the MOU was penned to 26.7% in 1990.

Canadian pressure is mounting to rewrite or eliminate the MOU. Canada's Minister for International Trade, John Crosbie, said at a press conference early in 1991 that "we are convinced that the time has come now for a review of the MOU with the U.S." He added that "the present situation is not one that we can tolerate much longer." Prime Minister Brian Mulroney told President Bush that Canada wanted to resolve the situation "in a reasonable way."

Another source of pressure on the industry is forest and wildlife protection. As in the U.S., the marbled murrelet seabird and the northern spotted owl have become the focal point of environmentalists, who wish to preserve these species and the old-growth forests where they nest. In addition, British Columbia's timber industry is fighting environmentalists' efforts to portray it as a destroyer of forests on par with tree cutters in the Brazilian rain forest. The environmentalists have taken their campaign to Europe, where they hope to encourage customers and the public to pressure British Columbia to avoid harvesting in sites not previously logged and to stop clear-cutting. Boycotts of Canadian forest products have been threatened. Meanwhile, the Canadian industry has suggested that independent audits be conducted on the country's forest management practices.

Pressure on the industry. This complicated array of forces—weak markets, the strong Canadian dollar, the MOU, and the environment—led a number of Canadian sawmills to close down or be put on the market in 1990-91.

For example, James Maclaren Industries Inc. was due to close its Maniwaki, Que., veneer and sawmill divisions in mid-1991 and put them up for sale. The firm, which was to release 110 workers, blamed its plight on losses over the last few years as well as the current difficult economic situation. Factors cited included the recession, high interest rates, a strong Canadian dollar, tough environmental demands, and the requirement to incorporate recycled fiber in the firm's newsprint.

Crestbrook Forest Industries Ltd. said it would permanently close its Creston, B.C., and Fort MacLeod, Alta., solid wood facilities because they "did not have an economic future." Together they lost C$4.3 million in 1990.

In mid-1991, International Forest Products Ltd. agreed in principle to buy Fletcher Challenge Canada Ltd.'s Vancouver, B.C.-based Hammond and Fraser Mills sawmills and associated fiber supplies for about $75 million. The companies expected to close the deal in December. If completed, the purchase would expand International Forest's logging and forestry operations by 75%. Hammond has an annual capacity of 100 million bd ft, and Fraser Mills has capacity for 140 million bd ft. International Forest was expected to sign a long-term contract with Fletcher Challenge Canada to provide its pulp and paper operations with fiber. FCC had been hurting for money after sinking $500 million into a rebuild and environmental upgrade of its Crofton, B.C., newsprint and market pulp mill.

The industry has also been impacted by native peoples' land claims, which sometimes have conflicted with timber harvest agreements. Some forest products companies halted logging at disputed sites, while others plunged ahead in spite of spirited resistance by aboriginal groups. In some cases, partnerships are being developed to encourage cooperation. For example, Fletcher Challenge Canada has negotiated contracts with local bands for logging, fire fighting, and tree planting.

Daishowa Canada Co. Ltd. and the Lubicon Lake band became embroiled in a dispute over logging by a subsidiary of the company in land claimed by the band. The logging site has been harvested for a dozen years and is within a forest-management area that the province had assigned to Daishowa. Some of the timber will be used to supply chips to Daishowa's Peace River, Alta., pulp mill. Lubicon chief Bernard Ominayak said Daishowa made a verbal agreement in March 1988 to stay out of a 10,000-km^2 region in northern Alberta until federal and provincial authorities settled the band's claims to the land. But late in 1990, subcontractors of Daishowa's Brewster Construction Ltd. subsidiary began clear-cutting in the region. Daishowa reportedly interpreted the understanding to hold for only 1988.

In spite of such disagreements, some timber assignments have gone ahead. Cariboo Fibreboard Ltd., Williams Lake, B.C., gained a provincial offer of a 25-year, nonreplaceable pulpwood agreement. The firm committed to begin construction of a $140-million, medium-density fiberboard plant at Williams Lake within a year and to finish the project within 30 months. Initially, Cariboo will have to rely on chip supplies from local mills. After ten years, if that supply is not sufficient, the firm will be allowed to harvest up to 265,000 m^3/year of nearby pulp timber in pulpwood agreement No. 19 area, following public review.

Canada:

ENERGY USE AND CONSERVATION

Energy consumption patterns differ across Canada, with natural gas being the principal fuel for the pulp and paper industry in the British Columbia Interior, while the coastal region uses both oil and gas extensively. Eastern Canada tends to use electric power, but residual oil is still a major fuel component in the pulp and paper industry in Quebec. Average energy prices also vary considerably throughout the provinces due, in good part, to an abundance of indigenous resources and local pricing policies.

Patterns of energy consumption differ widely for the Canadian industry's two main products—bleached kraft market pulp and newsprint. According to the Canadian Energy Research Institute, about 70% of the energy needed to make kraft pulp is supplied by process waste and woodwaste, while 3% is purchased electricity. In contrast, purchased energy accounts for over 40% of the energy needed to produce newsprint, and under 20% is recovered in the form of combustible wastes.

The Canadian Industry Program for Energy Conservation (CIPEC) reported a noticeable shift away from electricity use by Quebec pulp and paper mills in 1989 because of the directed shutdown of electric-powered steam boilers, many of which were inspired by Hydro-Quebec discounts. With less snowfall and increased forest fires, hydraulic generating capacities were reduced significantly in the province, and the curtailment in electric power resulted in increased use of fossil fuels. Another problem faced by mills in Quebec is that electricity generators are making more money by selling their output to users in New England. This competition from the stronger U.S. dollar also pushes up the price of electricity in eastern Canada.

Mills on Vancouver Island, B.C., will pay more for energy when a new natural gas pipeline is completed in 1992. In the face of legislation that would have ordered them to buy the natural gas, mills acquiesced to becoming customers of the pipeline. Western Pulp Ltd., Squamish, B.C., in August 1991 was the first of seven mills to receive gas from the C$340-million project built

PURCHASED ENERGY USE IN CANADA

(gigajoules per metric ton of paper produced)

Year	Electricity	Heavy fuel oil	Distillates	Natural gas	Coal	Other*	Total
1989	5.0	4.1	0.2	4.1	0.2	0.2	13.8
1988	5.6	3.1	0.2	3.6	0.2	0.0	12.7
1987	6.0	2.7	0.2	3.3	0.2	0.0	12.4
1986	6.1	2.9	0.2	3.3	0.2	0.1	12.8
1985	5.9	3.2	0.3	3.4	0.4	0.0	13.2
1984	5.7	3.6	0.3	3.5	0.4	0.0	13.5
1983	5.0	4.5	0.2	3.5	0.5	0.1	13.8
1982	5.0	5.6	0.3	4.0	0.5	0.2	15.6
1981	4.8	5.9	0.3	3.9	0.4	0.2	15.5
1980	4.5	6.0	0.4	3.9	0.5	0.2	15.5
1979	4.4	6.5	0.4	4.0	0.5	0.1	15.9
1978	4.7	7.0	0.3	3.9	0.6	0.2	16.7
1977	4.7	7.4	0.4	4.2	0.6	0.3	17.6
1972	4.5	9.0	0.3	3.8	0.7	0.2	18.5

*Purchased steam plus propane.
Source: Canadian Pulp & Paper Assn.

by Pacific Coast Energy. The 539-km pipeline will allow the seven mills to displace more than 2 million barrels of bunker fuel/year and eliminate 300 barge loads of oil.

But even with the rise and fall in oil prices resulting from the Gulf War, Canadian energy prices have not been a driving force in conservation programs since the last upswing in spot oil prices in 1979. With self-sufficiency, market deregulation, and free-market forces at work in the past few years, real costs of energy to Canadian manufacturers dropped a total of 0.9%, CIPEC reported. The motivation for improving energy conservation has therefore slackened.

Purchased energy per ton of production increased slightly for the Canadian pulp and paper industry in 1989, with the result that the reduction in purchased energy since the base year of 1972 now represents 25.8%, vs the industry's objective of 33% reduction for 1990, the Canadian Pulp & Paper Assn. reported. Electricity continues to be the major source of energy for the industry, accounting for 36.7% of total purchased energy. Heavy fuel oil is 30.1% of the total, which is 45% of the amount used on an equivalent production basis in 1972. Natural gas has increased to 29.5% of the total.

Increases in the use of heavy fuel oil and natural gas offset a continued reduction in the use of purchased electricity in electric boilers, CPPA said. Purchased electricity for motive power continued to increase in 1989, reflecting the trend of increasing mechanical pulping capacity. The reduction in fuel oil use is equivalent to 3.05 billion liters and in total purchased energy is equivalent to 2.93 billion liters of heavy fuel oil when compared with 1972.

Mills have also been very successful in exploiting waste products as an alternative source of fuel, but replacement of fossil fuels by woodwastes generated by the industry and neighboring wood products operations declined slightly during 1989, with woodwastes accounting for 64% of total fuels burned by the industry. Woodwaste accounted for 68% of the total fuel burned by the industry in 1988. Waste fuels plus captive hydraulic power accounted for 53% of total energy, up from 42% in 1972 but down from 57% of the total energy used in 1988, CPPA statistics show. Unlike in the U.S., cogeneration is not a widespread energy policy, although it has gained ground in Canada with the opening of a cogeneration plant in mid-1991 at the Fort Frances, Ont., paper mill. The C$100-million project was a joint venture between Boise Cascade Canada Ltd., Central Gas Ontario, and Ontario Hydro. The plant converts natural gas into steam and electricity sold to Ontario Hydro, while Boise uses the waste heat as steam power for the mill.

CANADIAN PAPER INDUSTRY CAPITAL SPENDING ON ENERGY AND POWER PROJECTS, 1990-92*

Region	Expenditures (000 C$)	% of total energy/power capital budgets
Maritimes	C$12,000	2%
Quebec	59,271	11
Ontario	151,250	27
Central	0	0
West	336,540	60
Total	**559,061**	**100**
% of total capital spending, all purposes	5.5%	

*Includes projects, as announced, for 1992 and beyond.

Provinces are assigned to regions as follows: Maritimes: New Brunswick, Newfoundland, Nova Scotia; Central: Manitoba, Saskatchewan; West: British Columbia, Alberta.

Source: *Pulp & Paper* Capital Spending Survey, January 1991.

CANADIAN PULP AND PAPER INDUSTRY PURCHASED ENERGY CONSUMPTION

Energy source	1972[1] joules x 10^{15}	% of total	1987[2] joules x 10^{15}	% of total	1988[2] joules x 10^{15}	% of total	1989[2] joules x 10^{15}	% of total
Coal	16.23	3.4	4.77	1.5	4.86	1.5	4.11	1.2
Petroleum products								
Residual oil	233.35	49.2	69.01	21.6	81.92	24.4	105.91	30.1
Distillates	8.74	1.8	4.72	1.5	4.76	1.4	4.83	1.4
Natural gas	95.68	20.2	85.26	26.7	94.02	28.1	103.96	29.5
Liquified petroleum gas	1.05	0.2	0.78	0.3	0.89	0.3	0.81	0.2
Other	4.94	1.0	1.65	0.5	1.41	0.4	3.27	0.9
Electricity (purchased)	114.87	24.2	152.79[3]	47.9	147.09[4]	43.9	129.42[5]	36.7
Total	**474.86**	**100.0**	**318.98**	**100.0**	**334.95**	**100.0**	**352.31**	**100.0**

1. Reported on 1972 unit use adjusted to 1989 production.
2. Actual use.
3. 32.91 x 10^{15} joules (10.3%) used in electric boilers.
4. 21.56 x 10^{15} joules (6.4%) used in electric boilers.
5. 3.18 x 10^{15} joules (2.5%) used in electric boilers.

Source: Canadian Pulp & Paper Assn.

Canada:

TRANSPORTATION

As one of the world's largest exporters of pulp, paper, and wood products, Canada's transportation system is a critical facet in the competitiveness of the country's forest products industry, especially with the U.S. as a major destination. Estimates show that transportation adds 15% to 20% to the final cost of Canadian forest products, consuming almost 10% of total industry sales. But after a decade of steady growth in railcar shipments of forest products, business fell off in 1989 and 1990 to levels similar to those reached just before the recession of the early 1980s.

Accounting for about 15% of all railcar loadings in 1990, forest products shipments declined 7.5% in 1990 to 32 million metric tons, compared with 34 million tons in 1989, reported Statistics Canada. Pulp and paper shipments by rail declined 1.7% in 1990 to 13 million tons, while pulpwood fell more dramatically, tumbling 16.2% to 8 million tons in 1990, compared with 1989. For the railroads themselves, a recovery in wheat shipments following a 1988 drought in Saskatchewan and Manitoba partly offset the loss in commodity traffic.

Two Class I freight railways handle 90% of all freight revenues in Canada: Canadian National (CN) Railway, a crown corporation, and Canadian Pacific (CP Rail), which is privately owned. CN carries about 30% more traffic than CP Rail and has about 30% greater earnings than CP Rail. CN experienced a 1.8% decline in traffic in 1990, while CP Rail increased its traffic by 2.4% on the strength of grain shipments, reported the National Transportation Agency of Canada (NTA). Both lines have benefited recently from modest growth in traffic originating in the U.S. but have

RAILCAR LOADINGS OF MAJOR CANADIAN RAILROADS, 1980-90

	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980
(000 cars loaded)											
Pulp and paper	211	217	227	220	217	213	211	196	191	219	227
Pulpwood	148	175	186	187	185	192	189	195	180	205	233
Other forest products	167	182	188	212	207	215	211	212	171	205	241
Total forest products	526	574	601	619	608	620	611	603	542	629	702
All railcar loadings	3,432	3,522	3,734	3,664	3,546	3,594	3,660	3,210	3,096	3,608	3,796
(000 metric tons)											
Pulp and paper	13,268	13,506	14,061	13,518	12,934	12,437	12,089	10,954	10,338	11,556	11,888
Pulpwood	8,153	9,734	10,489	10,487	10,590	10,806	10,574	11,102	9,960	11,157	12,563
Other forest products	10,548	11,331	11,451	12,316	11,228	11,384	11,048	10,815	8,527	9,713	10,935
Total forest products	31,969	34,571	36,001	36,321	34,752	34,627	33,710	32,871	28,825	32,425	35,386
Total traffic loaded	237,591	242,162	258,344	249,320	237,012	237,874	239,866	206,676	199,436	229,690	236,164

Source: Statistics Canada.

suffered from a drop of 1 million tons of British Columbia-originating traffic, mostly in pulpwood chips and lumber shipments.

Intermodal growth. Woodpulp, pulpwood chips, and newsprint, which account for about 10% of total traffic, remained relatively constant in 1990, with only minor offsetting increases and decreases, according to NTA. Lumber traffic declined again, primarily due to the softness of the U.S. housing market and also the stronger Canadian dollar. CN traditionally moves considerably more lumber traffic than CP Rail but suffered a 9% decrease in lumber traffic, compared with 4% for CP Rail.

Intermodal competition for pulp and paper has been much less pervasive in Canada than in the U.S., which has several competing rail lines plus various intermodal shipping systems using inland waterways and coastal sea routes. Canadian railways have invested heavily in modernizing their intermodal services in recent years. However, in 1990, intermodal traffic declined 3.1%. CN's intermodal traffic fell by 9.2%, while CP Rail's tonnage was up 2.9%. The CN drop in 1990 resulted primarily from a fall in the U.S. and eastern import markets destined for central Canada and for Quebec traffic to the U.S. The growth in CP Rail's intermodal traffic came mostly from U.S. shipments to Quebec. But intermodal transportation promises to grow in Canada as free trade between the two economies is acted out. During 1990, CN and CP Rail streamlined their respective networks and improved efficiency. The companies reduced their labor forces, expanded their intermodal services, and pursued a north/south realignment.

Pulpwood chips accounted for 22% of terminated traffic in British Columbia, on level with the 1980 figure, but as originated traffic, pulpwood chips accounted for 7% of British Columbia's traffic flow, compared with 15% in 1980. About 85% of the shipments moved mainly within British Columbia. In Quebec, pulpwood chips accounted for 9% of the total terminated traffic and 7% of the originating traffic in 1990. Both figures are slightly down from 1980. Newsprint accounted for 15% of Quebec-originating rail traffic in 1990, compared with 13% in 1980, and in Ontario, newsprint accounted for 4% of originating traffic in 1990. Woodpulp also accounted for 4% of rail shipments originating in Ontario in 1990.

Rates used to be set publicly, but now confidential contracts allow rail lines to tailor rates to the specific needs of shippers and to adjust rates in a timely and competitive manner. Each shipper has its own rates, which are dependent upon a particular cargo and destination as well as the bargaining strength or weakness of the carrier and its customers. The use of confidential contracts increased by 54% in 1989, and CN and CP Rail increased their 1990 contracts by 50% and 75%, respectively. Pulp and paper products continue to be a major commodity shipped through confidential contracts, especially in Quebec, NTA reported. For pulp and paper contracts, 96% of the origins were in Canada, mostly in Ontario and Quebec, but 45% of the destinations were in the U.S.

The structure of the Canadian trucking industry continued to evolve in 1990 in reaction to both domestic and international developments. The most significant structural changes arose from territorial and market expansions as well as market withdrawals, reported NTA. Reduced entry controls and increased north/south traffic have contributed to the emergence of a single North American market in surface transportation, both rail and truck. Auto parts in Ontario and newsprint in Quebec remain key trucking traffic markets. While railways maintain an advantage in long-distance travel, trucking has begun playing a larger role in shorter-distance hauls (up to 400 miles), particularly in the East, where mills are closer to market and loads can be delivered in 24 to 48 hours. The Free Trade Agreement has made it easier for American trucking firms to enter the Canadian market. Early 1991 saw record numbers of bankruptcies for Canadian trucking companies, with many Canadian firms setting up operations in the U.S. to take advantage of the lower cost base there.

In Canada, ocean liner trade is divided between conference carriers, a group of ocean carriers providing services on common trade routes who collectively agree on rates and conditions of services, and liner services, which use vessels operating on fixed itineraries and regular schedule. In terms of frequency, all major trades were serviced equally by conference and nonconference vessels, except for the eastern Canada-U.K./Continent trade, where nonconference shippers maintained a strong competitive presence. During 1990, the pronounced downturn in the Canadian and U.S. economies and sharp jumps in the price of bunker fuel due to the Persian Gulf crisis contributed to some changes in the ocean carrier industry in Canada.

FOREST PRODUCTS TRANSPORT STATISTICS 1987-89

(metric tons)

	Railways (domestic revenue freight) 1987	1988	1989	Trucking Class 1-2 1988	Marine traffic (total cargo tons loaded 1988)
Woodpulp	6,482	6,729	6,495	661	5,375
Newsprint	5,535	5,465	5,440	3,951	3,623
Paperboard, fiberboard	1,501	674	643	380	969
Pulpwood	1,543	1,279	1,068	993	8,137
Woodchips	9,074	9,150	8,168	8,807	n.a.
Total forest products	36,321	36,060	34,570	30,339	42,679
Total products	249,320	258,601	241,770	177,103	319,950
% of total products	14.6%	13.9%	14.3%	17.1%	13.3%

Source: Statistics Canada

Canada:

ENVIRONMENTAL SPENDING AND REGULATIONS

Difficult times in the pulp and paper industry have led Canadian producers to delay or cancel many capital projects. At the same time, the government is tightening pollution standards, which is forcing these manufacturers to fund environmentally driven projects.

Total capital expenditures among Canadian pulp and paper producers were expected to fall 22% to C$3.845 billion in 1991 after a 17% drop from 1989 levels, according to a survey by the Canadian Pulp & Paper Assn. The worst would then be over, with capital spending dropping just 3% between 1991 and 1992 to $3.740 billion. Most of the decline is due to a retreat from modernization and expansion.

On the other hand, spending on environmental projects, such as water and air pollution abatement equipment, showed a 50% hike to $785 million between 1989 and 1990 and promised to shoot up 31% in 1991 and 19% the following year to reach $1.225 billion. Overall, the environment sector will expand 133% over the four-year period. These shifts will have a significant impact on the sector's share of total expenditures. Back in 1989, environmental projects took up less than 10% of the $5.945-billion capital budget. By 1992, the environment is expected to consume one-third of the overall capital budget.

Pulp & Paper magazine's January 1991 capital spending survey found that Canadian pulp and paper firms expected to spend a total of $10.2 billion on mill projects during the 1990-92 period, down 21% from plans reported the previous year for 1989-91 (in this survey, the entire cost of a project is assigned to the startup year). Environmental improvements from 1990-92 were expected to cost $2.5 million—an increase of 23% over 1989-91 expenditures—with water quality issues dominant at $1.9 million. Western Canada was due to take the lion's share of the expenditures—nearly 75%.

Approval hurdles. The overall decline in capital spending is partly a result of weakening markets and the strong Canadian dollar, but uncertainty on the permitting front has also played a role. The $1.3-billion Alberta-Pacific Forest Industries bleached kraft pulp project in Alberta, for example, was held up for two years because of concerns over its environmental impact. Environmentalists fought to prevent construction of the new mill on an already-polluted, small, and slow-moving river system. Under pressure from the Canadian government as well, Alberta-Pacific eventually modified its proposed pulping process to reduce pollution, though critics of the methods involved are concerned that the company

ANNOUNCED SPENDING PLANS FOR ENVIRONMENTAL CONTROL PROJECTS, 1990-92

(000 $)

Region	Water	Air	Solid waste	Total
Maritimes	$63,575	$59,000	$6,325	$128,900
Quebec	319,129	69,135	35,071	423,335
Ontario	119,601	16,020	510	136,131
Central	0	0	0	0
West	1,391,379	417,675	25,929	1,834,983
Total	1,893,684	561,830	67,835	2,523,349
% of total pollution-control capital spending	75.0%	22.3%	2.7%	100.0%

Source: *Pulp & Paper*, "Capital Spending Survey: 1990-92," January 1991.

may find the technology does not work or is not as environmentally sound as predicted. The mill was finally approved and is scheduled to go online in 1993.

In another example, Procter & Gamble Cellulose Ltd. put the $365-million expansion of its Grande Prairie, Alta., bleached kraft market pulp mill on hold in 1990 for at least two years, hoping that federal and provincial regulations on pulp mill development would be more settled by the time the firm completes environmental studies near the mill. Among other goals, these studies will involve an assessment of the fish in the local Wapiti and Smoky rivers.

The regulatory situation in Canada has been confused for years, with individual provinces setting up their own pollution standards and policies. For instance, Quebec imposed a law in mid-1990 requiring companies to pay for cleaning up their own pollution or face fines up to $1 million and seizure of assets. Individual corporate officers could also face charges. Alberta set up a Natural Resources Conservation Board to review the environmental impact of forest-related projects. And in British Columbia, regulations were approved late in the year restricting the discharge of chlorinated organics in effluent to 2.5 kg adsorbable organic halide (AOX)/metric ton of pulp produced by December 1993. The provincial cabinet had originally approved a 1.5 kg/ton limit by 1994, but Premier William Vander Zalm vetoed that measure because of its cost to the industry. Studies due in two years will help determine whether or not the government drops the limit further, perhaps to 1.5 kg or less. Achieving the reduction to 2.5 kg reportedly would cost industry $1 billion, and the 1.5 kg level would cost another $600 million.

Federal standards. Such rule-making autonomy at the provincial level has created a patchwork of regulations that vary from province to province. To even out the playing field across the country, Canada recently set out to develop national pollution standards for pulp and paper mills.

In April 1990, Environment Canada issued proposed standards that were due to be finalized in mid-1991 and that, if approved, would be fully implemented by 1994. Subsequent revision based on comments and public consultation may permit mills an additional two years under extraordinary circumstances to meet Fisheries Act regulations. Among the proposals were Canadian Environmental Protection Act regulations that would require modification of the pulp bleaching process to prevent the formation of dioxins and furans. In addition, an update of the Fisheries Act would modify effluent discharge limits through the use of new measurement procedures and would require all mills to meet standards on suspended solids, oxygen-depleting substances, and acutely lethal effluents.

Environment Canada is also completing an assessment of the effluent at pulp mills that use bleaching. Controls will be developed based on the results of this assessment. The regulations mentioned in the previous paragraph would actually have the effect of bringing chlorinated organics, measured as AOX, below 2.5 kg/metric ton of pulp produced. Some have suggested that federal limits on chlorinated organics could be set as low as 1.5 kg/metric ton of pulp produced.

Major costs. Environment Canada has published estimates of the costs of meeting such limits. For example, Canadian Pacific Forest Products Ltd. might have to shell out $338 million to meet the 2.5 kg/metric ton limit on AOX or a total of $373 million to get down to 1.5 kg, according to the agency. Although some companies agreed with the estimates, others said they were too low. While Environment Canada estimated MacMillan Bloedel Ltd. might spend $194 million to meet the 2.5 kg limit, the company reportedly expects a bill closer to $275 million.

CPPA estimated that the expense for environmental improvements could reach $5 billion over the next several years. And that bill comes at a time when the industry is already under stress from collapsing earnings and would traditionally curtail capital spending. Given the weak profit situation, Brian Topp, forest product analyst with Capital Group Securities Ltd., said the industry would have to trim back all unnecessary capital expenditures and might have to finance the remaining essential projects through bank loans. Topp added that firms with heavy debt loads, such as Noranda Forest Inc. and Domtar Inc., would "have to try and catch up in 1992-94, when they start to do better."

Further environmental reforms are in the works. Late in 1990, Canada announced a sweeping $3-billion, five-year plan covering both new and previously announced measures to reduce pollution and improve the environment. The effort will include packaging reductions; proposals to limit industrial emissions, including dioxins and furans; new national parks; a program to be developed with the U.S. to prevent pollution in the Great Lakes; and cuts in acid rain and carbon dioxide emissions.

In addition, Canada and the U.S. finally overcame their differences over acid rain issues and signed an air pollution agreement early in 1991. Under the new U.S.-Canada Air Quality Accord, the U.S. must cut annual sulfur dioxide emissions to 10 million tons below 1980 levels by the year 2000. Canada will have to reduce emissions of sulfur dioxide to 3.2 million tpy by the year 2000. By that time, the U.S. must also drop its nitrogen oxide releases to 2 million tons below 1980 levels, and Canada reportedly will undertake a comparable reduction program. In addition, the pact includes provisions for continued dialog on cross-border air pollution issues.

Regulatory authorities are punishing pulp and paper firms for environmental slipups, and the penalties are adding up. Cariboo Pulp & Paper Co.'s parent companies were fined $275,000 for the firm's environmental mishaps. Daishowa Marubeni International Ltd. and Weldwood of Canada Ltd. agreed to the fine for a release of turpentine gas in May 1989 and for effluent discharge into the Fraser River in February 1990. Fibreco Pulp Inc. was fined $200,000 for a black liquor spill into the Peace River in British Columbia. The release reportedly occurred early in 1990 while the firm was setting up a waste treatment system. Canadian Pacific Forest Products was fined $50,000 late in 1990 for dumping woodfiber into an inlet near its new Vancouver Island, B.C., newsprint mill during a three-week period the previous November. The company blamed the spill on startup problems.

A spill of 400,000 to 500,000 liters of partially treated effluent occurred at Howe Sound Pulp & Paper Ltd.'s Port Mellon, B.C., pulp mill as the company was starting up its new $27-million effluent treatment system in September 1990. The spill was caused by a pump failure. The firm said some of the spillage was contained in a natural depression at the site and recovered. Howe Sound was fined $175,000 for this spill and for exceeding effluent limits at the mill in May 1989.

Environmental projects. Howe Sound has recently spent millions on the Port Mellon facility, expanding pulp capacity, adding a newsprint mill, and giving it an environmental face-lift. Of a total project cost of $1.1 billion, environmental protection measures absorbed $114 million, covering chlorine dioxide substitution in the bleaching process; a two-stage, medium-consistency oxygen delignification system from Kamyr; and the activated sludge secondary treatment system. Howe Sound's two-line bleaching system runs on a DCEODND sequence, with the option to swing the first stage entirely over to chlorine dioxide. The mill will also be able to operate with other bleaching systems utilizing a combination of oxygen, peroxide, and other compounds. The Port Mellon facility reportedly will be one of the few plants to meet proposed environmental standards as they are issued by the federal and provincial governments over the next several years.

In mid-1991, Canadian Pacific Forest Products began installing a $60-million effluent treatment system, part of a $98-million environmental upgrade project at its Gold River mill. CP Forest said the system will eliminate effluent toxicity and significantly cut biochemical oxygen demand, suspended solids, and chlorinated organics. These improvements will bring the mill into compliance with provincial environmental regulations going into effect in March 1993 as well as proposed federal regulations.

Toward the close of 1990, Procter & Gamble Cellulose started up its Grande Prairie bleached kraft market pulp mill after a 60-day shutdown for major maintenance and an environmental upgrade. The bill for the project topped $80 million. That included $38 million to complete an R8 chlorine dioxide generator so the firm could reduce the amount of molecular chlorine used in the bleach plant. P&G also did a "major rebuild" of the plant's recovery boiler, replacing its bottom and the lower 40 ft of the side walls of the furnace. Composite tubes were installed, one economizer tube bundle was replaced, and more than 1,400 generating bank tubes were also replaced. Additional superheater tubes were put in the boiler, and a new concentrator for black liquor firing was installed. The third part of the overhaul entailed normal maintenance.

Much of the upgrade was aimed at meeting organochloride standards currently being developed. The work did not increase the mill's capacity. But the firm is in the midst of environmental river studies for a proposed $365-million expansion of the mill. The expansion has been put on hold for at least two years pending completion of these tests.

Long delays related to environmental issues are becoming more common. Celgar Pulp Co. had to place an expansion plan for its Castlegar pulp mill before a federal-provincial environmental review panel—the first such review for a British Columbian pulp mill. The $700-million project was announced in October 1989, the panel was appointed in mid-1990, and after the expansion was approved, construction was finally begun in February 1991. The panel was set up under British Columbia's major project review process and the federal environmental assessment and review process, and it concentrated on air and water quality, woodchip supply sources, and the impact of greater truck traffic.

The Castlegar mill possessed a poor environmental record—in part because British Columbia had given it variance permits over the years, and the panel included 50 suggestions related to design, operation, and monitoring in its final report. The expansion, due online in 1993, will incorporate an oxygen delignification system; chlorine dioxide generators; a large, low-odor recovery boiler with electrostatic precipitators; a collection and disposal system for odorous emissions; and a secondary treatment plant.

In some cases, environmental costs have been getting out of hand. Fletcher Challenge Canada Ltd. was forced to sell some assets because of major environmental and modernization expenditures. The firm blamed its fiscal troubles on a $500-million rebuild and environmental upgrade project at its Crofton, B.C., newsprint and market pulp mill. To get out of its financial hole, Fletcher Challenge Canada in mid-1991 agreed in principle to sell its Vancouver, B.C.-based Hammond and Fraser Mills sawmills and associated fiber supplies to International Forest Products Ltd. for about $75 million.

For the most part, however, the pulp and paper industry will be able to survive the hardships imposed by Canada's developing environmental awareness. And the country's vigilance is already paying off. Biochemical oxygen demand discharges from Canadian mills dropped from 1,411 metric tpd in 1980 to 335 tpd in 1989, according to CPPA. Total suspended solids discharges fell from 911 tpd to 240 tpd over the same period. Chlorine consumption in 1990 was half of what it was two years earlier. And dioxin and furan formation declined to 150 g/year in 1990, half the 1989 level. CPPA predicted that figure would drop to 10 g in "the next year or so." AOX levels were down to an average of 3 kg/ton of production. Despite these improvements, the industry has further progress to make and will have to bear the financial burden for years to come.

Paper:

INTRODUCTION

A number of factors determine the organization of paper grades and may affect a reorganization in the future. These factors include grade crossover into various end uses (prime examples are supercalendered [SC] paper and lightweight coated free-sheet, which are entering the publication sector now dominated by coated groundwood) and the introduction of recycled fibers. Currently, however, we still classify paper grades according to overall end use: 1) newsprint, 2) printing papers, 3) fine or writing papers, 4) packaging and converting papers, and 5) tissue papers.

Newsprint is distinguished from other printing and publication papers due to the fact that it is a more basic product whose mills have fewer value-added systems—such as coaters or supercalenders—than printing paper mills. Newsprint is the crudest and least expensive publication paper. Printing papers include uncoated groundwood—a value-added relative of newsprint—coated groundwood, uncoated free-sheet, coated free-sheet, and some printing bristols, both coated and uncoated. Fine or writing papers are dominated by uncoated free-sheet, though occasionally coated papers are also used. Packaging and converting papers include such grades as unbleached kraft sack paper for paper bags and envelope paper. Tissue paper is used primarily in toilet and facial tissue, toweling, and napkins.

Though paper grades can be further classified by fiber content, rapidly changing papermaking technology is making it increasingly useful to classify by end use. Similarly, a paper machine that makes one grade of paper may also be capable of producing paper of a different classification. For example, a paper machine might produce both bristols and bleached paperboard.

Factbook chapters are organized according to classifications established by three sources: the U.S. Bureau of the Census, the American Paper Institute, and the Canadian Pulp & Paper Assn. Eight major subgroupings are commonly understood and accepted by the paper industry:

- Newsprint
- Uncoated groundwood (mechanical) papers
- Coated papers
- Uncoated free-sheet (woodfree) papers
- Cotton-fiber papers
- Bristols
- Packaging and industrial converting papers
- Tissue.

Chapters detail production and market distinctions within these categories, along with important trends in production techniques or end uses.

Fourdrinier paper machines or machines with twin-wire formers most commonly produce these grades, though

ECONOMIC GROWTH OUTLOOK

	1988	1989	1990	1991
Gross National/Domestic Product				
United States	4.5%	2.5%	0.8%	0.8%
Canada	5.0	2.9	0.5	0.7
Germany	3.4	4.0	4.5	3.0
France	3.8	3.7	2.6	2.6
United Kingdom	4.0	1.8	1.4	1.5
Italy	3.9	3.3	3.1	3.0
Japan	5.8	5.0	5.8	3.9
Consumer price inflation				
United States	4.1%	4.8%	5.6%	6.6%
Canada	4.0	5.0	5.6	6.9
Germany	1.2	3.4	3.1	4.5
France	2.7	3.7	3.3	5.0
United Kingdom	4.9	7.8	9.8	8.0
Italy	5.1	6.2	5.8	6.5
Japan	0.7	2.4	3.4	3.6

Source: Resource Information Systems Inc.

some may be made on cylinder board machines or with multi-ply formers. Paper machines are increasing in size, with some rated at nearly 400,000 tpy, as opposed to many older machines that were responsible for 150,000 tpy or even less. Thus, fewer paper machines are producing more paper. In 1975, 981 machines manufactured 28.9 million tons of paper, while 1989 saw an additional 12.4 million tons of paper produced by 123 fewer machines. This trend has been consistently apparent for all paper grades, with the exception of newsprint (see table on p. 134). A machine's configuration is determined by the primary grade of paper to be manufactured or a paper mill's particular requirements for its own product (dictated by location, end use(s), or other factors).

In the papermaking process, woodchips or other fibers are turned into pulp and then mixed with water to produce a slurry of fibers. As the resulting slush is composed of 90% water, it is drained (dewatered) on a wire, with further excess water removed by pressing and drying. The dried sheet is wound on a reel (winder) from which rolls or sheets of paper are produced and, depending on the extent of mill-level conversion, sent to customers ranging from business forms and envelope converters to wholesale warehouse office supply stores.

Although mills may produce similar grades of paper(s), they do not make the paper in exactly the same method or with the same equipment. For example, the increased emphasis on recycled-content products means that one newsprint mill may manufacture products on a twin-wire former using 100% wastepaper, while a similar-quality newsprint can be produced on a fourdrinier machine using groundwood pulp. Naturally, newer mills are able to take advantage of the newest, most sophisticated equipment. These machines are often designed for commodity grades that can be produced in large volume, such as copy paper and offset printing paper. Older mills, some of which have been around for 100 years, are still in operation, but due to high operating expenses, they generally focus on higher-valued

U.S. PRODUCTION AND CAPACITY FOR PAPER GRADES

(000 short tons)

	Production[1]		Capacity[2]		
Year	Tonnage	Change (%)	Tonnage	Change (%)	Utilization rate (%)
1993e	45,215	2.8%	45,923	1.7%	98.5%
1992e	43,975	5.0	45,135	2.7	97.4
1991e	41,881	4.6	43,969	4.2	95.3
1990p	40,026	5.0	42,212	2.5	94.8
1989r	38,133	-0.4	41,165	2.4	92.6
1988	38,298	3.9	40,211	2.9	95.2
1987	36,876	5.8	39,080	2.8	94.4
1986	34,859	5.1	38,014	1.2	91.7
1985	33,179	0.6	37,581	1.3	88.3
1984	32,989	9.4	37,106	4.0	88.9
1983	30,151	-0.9	35,675	2.8	84.5
1982	30,422	2.0	34,696	2.9	87.7
1981	29,816	-1.5	33,706	3.2	88.5
1980	30,281	2.4	32,659	4.7	92.7
1979	29,580	4.7	31,179	2.4	94.9
1978	28,253	0.6	30,460	2.1	92.8
1977	28,096	5.6	29,831	2.1	94.2
1976	26,612	14.2	29,210	1.0	91.1
1975	23,306	-12.6	28,922	1.4	80.6
1974	26,651	0.6	28,532	3.3	93.4
1973	26,483	4.1	27,621	1.7	95.9
1972	25,435	6.8	27,156	3.4	93.7
1971	23,811	0.8	26,270	1.8	90.6
1970	23,625	0.1	25,806	2.2	91.5
Average 1970-93		2.9%		2.6%	

e = Estimate.
p = Preliminary.
r = Revised.

[1] Bureau of the Census data. Includes newsprint, printing/writing, packaging and industrial papers, and tissue.

[2] American Paper Institute.

CANADIAN PRODUCTION AND CAPACITY FOR PAPER GRADES

(000 short tons)

	Production[1]		Capacity[1]	
Year	Tonnage	Change (%)	Tonnage	Change (%)
1992e	n.a.	—	18,519	2.6%
1991e	n.a.	—	17,642	6.3
1990	15,056	-1.6%	16,713	5.1
1989r	15,303	-0.5	16,273	3.8
1988r	15,376	4.5	15,677	3.0
1987r	14,710	5.2	15,225	2.0
1986r	13,985	5.3	14,921	3.2
1985r	13,284	2.2	14,458	1.3
1984r	12,994	6.5	14,270	0.9
1983r	12,196	6.3	14,149	1.9
1982r	11,478	-9.2	14,012	3.8
1981	12,640	3.6	13,502	4.0
1980	12,200	-0.5	12,975	0.9
1979	12,259	0.9	12,855	2.0
1978	12,148	9.0	12,603	0.9
1977	11,146	3.6	12,493	0.8
1976	10,757	17.1	12,396	1.0
1975	9,186	-22.0	12,275	0.9
1974	11,782	6.0	12,168	-1.0
1973	11,120	3.9	12,292	1.4
1972	10,700	4.7	12,121	—
1971	10,215	-1.4	—	—
1970	10,357	-0.1	—	—

e = Estimate.
r = Revised.

[1] Includes newsprint, groundwood printing and specialties, book and writing (uncoated woodfree and coated after 1987), kraft, tissue, and special; excludes building papers.

Source: Canadian Pulp & Paper Assn.

niche or specialty grades. Many older mills are good candidates for using recycled furnish since they are nonintegrated and do not have their own pulp mills. Those beyond redemption, however, are being shut down.

ENVIRONMENT 101

Though there are other chapters in *Factbook* that examine various aspects of environmental issues related to the pulp and paper industry, this is a good opportunity to assess some of the effects of the rising environmental consciousness on the paper side of the business. (Chapters on environmental spending and regulations, wastepaper, and paper grades go into more detail on specific issues.) Mills, converters, merchants, printers, publishers, and other businesses that use paper have come to the realization that recycling is an issue that will not go away.

There may be as many as 2,000 separate local, regional, and national pieces of legislation that in some way restrict the papermaker's business. The most obvious of these is the requirement for a specific percentage of recycled fiber content within various paper grades. Currently, California has the toughest rules, requiring that state agencies buy paper that contains at least 40% postconsumer recycled fiber. Though the state has not yet set in place an enforcement mechanism, the industry worries that other states will follow suit. However, California's law was in part a response to what many perceived to be indifferent environmental concern from such agencies as the U.S. Environmental Protection Agency, which required only 50% recycled fiber content, without specifying any postconsumer or postcommercial deinked fiber.

PUBLICATION PRINTING TECHNOLOGY PROCESS CHANGES: 1990-92*

	1990	1991e	1992e
Offset	78.9%	79.4%	78.9%
Gravure	21.1	20.6	21.1

*Percentage of use by magazine publishers.
e = Estimate.
Source: 1991 Magazine Publishers of America, "Paper Outlook."

Environmental pressures are "clearly one of the most profound challenges to our business," says W. Craig McClelland, president and COO of Union Camp Corp. "The 'green' phenomenon is worldwide. It focuses not on what has been done in the past, but what they expect for the future." He adds, "I believe there is no other industry that can match the positive record of our paper industry in working to improve the environment. The facts on this are very clear. But central to the environmental issue is that over the long term, it is the marketplace more than government regulation that is the answer to bringing about improvements in the environment."

McClelland told delegates of *Pulp & Paper*'s White Paper Markets II Conference in April 1991 that the current environmental movement is no less important than the one a couple of decades ago. "I believe the intensity is as severe as it was in the 1970s. Back then, the priority in running a paper company for customers and shareholders became almost secondary to trying to be in compliance with environmental regulations. Today, for a company in the white paper business to survive, it must not only comply with regulations in the processes but also be perceived in the marketplace as environmentally friendly. The environment has become as much a public relations and a marketing issue as it has always been a manufacturing issue. If you fail to comply with the users' desires environmentally, then you lose their business."

It is indeed true that more customers are demanding recycled-content papers.

Red Cavaney, president of API, agrees with McClelland. "Industry's behavior—and the public's perception of that behavior—is vital to your future success," he told White Paper II delegates. "If the industry is viewed as part of the problem, rather than part of a solution, your ability to position your product in their best light is going to be compromised."

Cavaney points to the municipal solid waste issue as an example for illustration. He notes that although 40% of all solid waste is comprised of paper and paperboard, 80% of all U.S. postconsumer recy-

PULP AND PAPER OUTLOOK

(operating rates %)

	1990*	1991	1992	1993	1994	1995
Pulp[1]	86.3%	87.0%	91.2%	92.5%	89.8%	86.1%
Newsprint						
U.S.	96.7	92.5	94.2	95.7	94.0	94.2
Canada	98.2	91.5	93.0	94.7	92.5	92.7
Uncoated groundwood[2]	96.6	96.0	96.5	93.1	89.0	90.5
Coated	88.0	87.0	90.2	92.0	89.5	91.5
Uncoated free-sheet	92.0	90.0	93.0	95.0	91.0	93.0
Containerboard[3]	91.7	91.9	94.6	94.4	90.4	91.8
Kraft[4]	90.5	93.7	95.0	95.8	95.8	94.3

*1990 is net of capacity lost to strikes.
1. Worldwide paper-grade market pulp.
2. U.S. mills.
3. Unbleached kraftliner.
4. Unbleached.
Source: Resource Information Systems Inc.

cling is also paper and paperboard. "The public is creating a new marketplace, one much more complex in its decision points," Cavaney says. "More information will be required to sell our products. And, yes, there will still be plenty of room for companies to distinguish themselves and their products from the competition. But the new marketplace will make it imminently more difficult for a company to succeed, if the industry to which it is a part is seen as unresponsive and out-of-step with the times."

RELATIVE GROWTH RATES OF PRINTING/WRITING GRADES, 1981-89

	Coated		Uncoated	
Region	**Free-sheet**	**Groundwood**	**Free-sheet**	**Groundwood**
United States	5.2%	4.7%	4.2%	2.2%
Canada	8.5	13.9	7.6	12.9
Scandinavia	12.4	15.0	8.9	5.3
Western Europe	8.6	6.6	4.5	2.0
Latin America	9.4	—	5.4	23.7
Japan	10.1	17.9	8.0	3.5
China	—	—	—	—
Eastern Europe	17.3	—	7.9	12.6
Australasia	—	—	—	—
Pacific Rim*	24.8	—	13.7	19.3
U.S.S.R.	—	—	—	—
Africa	—	—	9.8	15.9

*Excludes China and Japan.
Source: Lehman Bros.

ESTIMATED NUMBER OF MACHINES AND TOTAL CAPACITY IN U.S.—1975 AND 1989

	1989		1975	
	Number	**Annual capacity (000 tons)**	**Number**	**Annual capacity (000 tons)**
Total paper	858	41,165	981	28,922
Newsprint	40	6,296	38	3,848
Printing/writing and related	421	23,637	475	14,274
Packaging/industrial converting	176	5,435	228	6,368
Tissue	203	5,798	240	4,432

Source: American Paper Institute capacity surveys.

FREE-SHEET/GROUNDWOOD PAPER MIX, 1989

	Free-sheet			Groundwood		
Region	**Coated**	**Uncoated**	**Total**	**Coated**	**Uncoated**	**Total**
United States	15.0%	58.0%	73.0%	18.8%	8.2%	27.0%
Canada	4.5	33.2	37.7	10.4	51.9	62.3
Scandinavia	10.2	27.7	37.9	24.3	37.7	62.0
Western Europe	19.3	37.0	56.3	26.4	17.3	43.7
Latin America	7.8	84.8	92.6	0.2	7.2	7.4
Japan	28.6	35.5	64.1	12.0	23.9	35.9
China	n.a.	n.a.	—	n.a.	n.a.	—
Eastern Europe	4.4	61.1	65.5	0.0	34.5	34.5
Australasia	0.0	0.0	0.0	0.0	0.0	0.0
Pacific Rim*	33.0	47.3	80.3	0.0	19.7	19.7
U.S.S.R.	n.a.	n.a.	—	n.a.	n.a.	—
Africa	0.0	88.4	88.4	0.0	11.6	11.6

*Excludes China and Japan.
Source: Lehman Bros.

U.S. SHIPMENTS[1] OF PAPER GRADES, 1976-89

(000 short tons)

	1989	1988r	1987	1986	1985	1984	1983
TOTAL, ALL GRADES	38,074	38,006	36,199	35,510	33,179	32,989	32,205
PRINTING/WRITING AND RELATED PAPERS	27,879	27,949	26,691	25,448	23,861	23,925	22,662
Newsprint	6,024	5,913	5,831	5,638	5,503	5,620	5,266
Uncoated groundwood paper	1,764	1,647	1,544	1,574	1,564	1,723	1,604
Publication and printing	1,465	1,366	1,363	1,354	1,361	1,488	1,383
Supercalendered[2]	446	384	(D)	(D)	(D)	345	394
Other	1,019	982	1,000	1,016	1,004	1,143	989
Other converting and miscellaneous	152	139	(D)	(D)	(D)	(D)	(D)
Body stock for coating	—	—	(D)	(D)	(D)	(D)	(D)
Coated printing and converting paper	7,544	7,612	7,064	6,521	6,036	6,469	5,852
Coated groundwood (more than 10% groundwood)	4,151	4,090	3,861	3,598	3,384	3,708	3,526
Coated one side	—	—	(D)	(D)	(D)	(D)	(D)
Coated two side	—	—	(D)	(D)	(D)	(D)	(D)
Coated free-sheet (10% groundwood or less)	3,393	3,523	3,203	2,923	2,651	2,761	2,326
Coated one side	581	592	480	482	582	580	472
Coated two side	2,812	2,931	2,723	2,441	2,069	2,181	1,853
Prime coated stock for coating	—	—	—	—	—	(S)	(S)
Uncoated free-sheet (10% groundwood or less)	10,870	11,117	10,777	10,303	9,454	8,726	8,572
Writing (chemical woodpulp)	6,314	6,312	5,934	5,606	5,299	4,992	4,837
Bond and writing, including protective check	3,075	2,936	2,698	2,437	2,316	2,247	2,142
Forms bond in rolls	1,980	2,038	2,017	2,050	1,901	1,744	1,663
Ledger	60	63	63	69	66	62	62
Mimeograph (all woodpulp furnishes)	25	28	32	85	76	81	84
Gelatin and spirit process duplicating	31	39	52	144	158	161	191
Papeterie and wedding	51	43	47	47	50	55	47
Body stock for communication, copying	347	337	334	283	237	246	203
Other technical and reproduction	344	369	376	172	176	156	123
Tablet	342	396	266	267	264	185	274
Other (onion skin, manifold, etc.)	60	63	61	53	55	55	49
Publication and printing	2,714	2,858	2,950	2,852	2,472	2,342	2,193
Plain (MF, EF, antique, bulking, SC)	324	336	334	334	266	286	265
Offset	1,786	1,889	2,011	1,909	1,622	1,551	1,448
Other publication and printing	604	634	606	609	584	504	480
Cover and text papers	450	447	411	367	378	386	372
Other converting and miscellaneous	1,392	1,500	1,481	1,479	1,305	1,006	1,170
Envelope (white woven)	732	772	713	714	666	668	627
Kraft envelope, bleached and brown	364	388	374	376	354	(D)	350
Coating basestock	296	340	394	390	—	—	—
Bleached bristols[3]	1,252	1,218	1,091	973	897	940	928
Tabulating card stock	—	—	(D)	(D)	(D)	68	107
Tag and file folder	438	430	414	389	363	356	364
Tag	201	203	207	212	200	214	215
Folder	237	226	207	178	164	141	149
Other uncoated (index, printing, postcard)	339	345	325	295	268	215	240
Coated	475	443	352	289	266	302	217
Cotton-fiber writing paper and thin paper	425	442	383	439	408	447	440
Writing, cotton-fiber	163	161	121	168	145	144	160
Bond and writing	133	135	94	131	126	125	131
Other	30	26	27	36	19	19	29
Thin paper	262	281	262	271	262	303	280
Carbonizing free from groundwood pulp	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Other[4]	(D)	(D)	(D)	(D)	(D)	(D)	(D)

Continued

U.S. SHIPMENTS[1] OF PAPER GRADES, 1976-89 (continued)

(000 short tons)

	1982	1981	1980	1979	1978	1977	1976
TOTAL, ALL GRADES	30,151	29,816	30,164	29,580	28,506	28,906	26,534
PRINTING/WRITING AND RELATED PAPERS	20,986	20,791	20,362	19,271	18,482	17,923	16,784
Newsprint	5,063	5,253	4,660	3,778	3,489	3,525	3,526
Groundwood paper, uncoated	1,499	1,428	1,538	1,800	1,569	1,588	1,460
Publication and printing	1,299	(D)	—	—	—	—	1,301
Supercalendered[2]	248	(D)	156	161	324	334	—
Other	1,046	1,073	1,138	1,420	1,030	1,086	—
Other converting and miscellaneous	(D)	200	—	—	215	168	158
Body stock for coating	(D)	(D)	243	220	(D)	(D)	(D)
Coated printing and converting paper	5,224	4,775	4,751	4,580	4,513	4,215	4,063
Coated groundwood (more than 10% groundwood)	3,115	2,646	—	—	—	—	—
Coated one side	(D)	77	123	118	—	—	—
Coated two side	(D)	2,568	2,572	2,307	—	—	—
Coated free-sheet (10% groundwood or less)	2,109	2,129	—	—	—	—	—
Coated one side	450	455	356	364	477	439	—
Coated two side	1,659	1,674	—	—	—	—	—
Prime coated stock for coating	(S)	(S)	1,700	1,791	4,036	3,776	(D)
Uncoated free-sheet (10% groundwood or less)	7,890	7,965	8,008	7,655	7,315	7,036	*
Writing (chemical woodpulp)	4,451	4,485	4,066	3,815	3,589	3,524	3,094
Bond and writing, including protective check	1,946	1,813	1,616	1,447	1,415	1,322	1,255
Forms bond in rolls	1,535	1,555	1,327	1,330	1,179	1,191	911
Ledger	60	99	107	117	63	67	64
Mimeograph (all woodpulp furnishes)	80	102	98	88	103	119	109
Gelatin and spirit process duplicating	164	178	301	234	196	166	166
Papeterie and wedding	49	61	48	62	55	48	50
Body stock for communication, copying	174	238	356	307	169	171	145
Other technical and reproduction	115	141	122	126	157	153	153
Tablet	269	221	315	299	219	203	225
Other (onion skin, manifold, etc.)	59	77	91	109	250	286	231
Publication and printing	2,064	2,206	2,127	2,048	2,199	2,082	1,904
Plain (MF, EF, antique, bulking, SC)	217	342	(D)	(D)	201	147	154
Offset	1,393	1,443	1,930	1,837	1,987	1,921	1,737
Other publication and printing	454	421	(D)	(D)	—	—	—
Cover and text papers	353	272	263	280	219	196	178
Other converting and miscellaneous	1,022	1,002	(D)	(D)	1,308	1,234	1,070
Envelope (white woven)	575	547	620	659	609	623	588
Kraft envelope, bleached and brown	304	295	272	205	212	195	—
Coating basestock	—	—	—	—	—	—	—
Bleached bristols[3]	879	904	941	957	1,127	1,108	1,041
Tabulating card stock	123	153	202	217	311	338	354
Tag and file folder	316	311	285	310	313	280	247
Tag	191	176	196	199	214	191	163
Folder	125	135	89	112	99	90	84
Other uncoated (index, printing, postcard)	234	209	222	188	239	232	228
Coated	205	231	232	242	264	258	211
Cotton-fiber writing paper and thin paper	430	466	464	502	469	450	**
Writing, cotton-fiber	134	113	131	130	119	111	103
Bond and writing	116	90	93	91	86	92	76
Other	17	23	7	7	8	7	5
Thin paper	297	353	333	371	350	339	345
Carbonizing free from groundwood pulp	(D)	(D)	196	238	224	212	198
Other[4]	(D)	(D)	137	134	126	127	148

Continued

U.S. SHIPMENTS[1] OF PAPER GRADES, 1976-89 (continued)

(000 short tons)

	1989	1988r	1987	1986	1985	1984	1983
PACKAGING AND INDUSTRIAL CONVERTING PAPER	4,744	4,875	4,624	4,643	4,697	4,976	5,097
Unbleached packaging, industrial converting	2,953	2,984	2,790	2,892	3,065	3,377	3,391
Wrapping	68	81	(D)	57	77	83	90
Shipping sack	674	734	695	673	755	816	727
Bag and sack other than shipping sack	1,658	1,609	1,512	1,648	1,712	1,951	1,860
Specialty packaging (92 lb and under)[5]	68	71	(D)	61	109	122	326
Other converting, including creping (92 lb and under)[6]	485	489	460	458	412	405	388
Packaging, industrial converting, except unbleached kraft wrapping	1,117	1,167	1,136	1,023	950	901	902
Wrapping (MG and MF butchers, miscellaneous wrapping)	50	62	47	33	33	50	65
Shipping sack, including combination kraft and rope	228	220	200	172	118	113	119
Unbleached and bleached sulfite, semibleached and bleached kraft; mixtures	213	—	191	161	108	91	95
Other shipping sack paper	15	—	9	11	11	21	24
Other bag and sack	231	229	192	204	240	209	168
Unbleached and bleached sulfite, semibleached and bleached kraft	160	160	130	142	170	137	121
Other bag and sack paper	71	69	62	63	70	72	46
Other converting (19 lb and over)	153	193	226	206	178	186	209
Waxing stock (18 lb and up)	109	126	147	148	130	132	157
Other, such as asphalting and creping stock	44	68	79	57	48	51	53
Specialty packaging	207	206	205	192	168	166	132
Glassine, greaseproof, and vegetable parchment	248	257	266	216	212	181	209
Special industrial paper	674	724	697	727	682	697	804
TISSUE	5,451	5,183	4,885	4,768	4,620	4,089	4,446
Sanitary paper	5,291	5,019	4,740	4,638	4,494	3,953	4,337
Toilet tissue	2,097	1,921	1,798	1,809	1,833	1,490	1,742
Single-ply	1,156	1,141	1,077	1,127	1,198	955	941
Multi-ply	941	779	721	682	635	534	802
Facial tissue, excluding toweling, napkin, and toilet	332	326	301	303	302	285	292
Napkin	699	679	626	595	596	529	594
Single-ply	519	506	432	431	451	401	467
Multi-ply	180	173	194	165	144	128	127
Toweling, excluding wiper stock	1,858	1,767	1,715	1,644	1,521	1,363	1,449
Sanitary napkin stock wadding	(D)	(D)	(D)	(D)	(D)	73	99
Wiper stock, regular, facial, and wadding type	156	186	178	156	111	109	60
Other sanitary stock	150	141	122	131	131	104	99
Tissue paper, excluding sanitary and thin	160	163	145	130	126	136	110
Wrapping tissue	77	77	69	59	56	69	(D)
Waxing tissue stock	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Creped wadding for interior packaging	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Other tissue, excluding sanitary and thin	33	36	28	23	24	31	20

Continued

U.S. SHIPMENTS[1] OF PAPER GRADES, 1976-89 (continued)

(000 short tons)

	1982	1981	1980	1979	1978	1977	1976
PACKAGING AND INDUSTRIAL CONVERTING PAPER	4,873	4,994	5,327	5,708	5,778	5,931	5,727
Unbleached packaging, industrial converting	3,308	3,586	3,718	3,911	3,872	4,061	3,917
Wrapping	85	103	137	187	210	218	201
Shipping sack	787	967	1,062	1,110	1,019	1,073	1,102
Bag and sack other than shipping sack	4,154	2,012	2,101	2,115	2,092	2,212	2,125
Specialty packaging (92 lb and under)[5]	251	165	2,074	2,085	2,064	2,182	2,076
Other converting, including creping (92 lb and under)[6]	331	340	419	499	551	558	488
Packaging, industrial converting, except unbleached kraft wrapping	828	923	1,145	1,266	1,408	1,346	1,224
Wrapping (MG and MF butchers, miscellaneous wrapping)	67	80	103	119	155	136	134
Shipping sack, including combination kraft and rope	105	118	92	102	92	107	120
Unbleached and bleached sulfite, semibleached and bleached kraft; mixtures	(D)	84	(D)	(D)	(D)	(D)	—
Other shipping sack paper	(D)	34	(D)	(D)	(D)	(D)	97
Other bag and sack	143	176	229	250	273	304	261
Unbleached and bleached sulfite, semibleached and bleached kraft	105	124	155	170	217	198	140
Other bag and sack paper	38	51	73	80	55	106	121
Other converting (19 lb and over)	183	163	251	287	264	236	407
Waxing stock (18 lb and up)	136	120	98	113	76	69	109
Other, such as asphalting and creping stock	47	42	52	59	—	—	115
Specialty packaging	124	209	269	273	365	344	—
Glassine, greaseproof, and vegetable parchment	206	177	202	234	259	219	202
Special industrial paper	737	485	464	531	498	524	586
TISSUE	4,291	4,031	4,474	4,601	4,246	4,243	4,123
Sanitary paper	4,185	3,917	4,298	4,403	4,036	4,045	3,930
Toilet tissue	1,679	1,533	1,706	1,772	1,629	1,605	1,566
Single-ply	962	944	939	978	939	877	916
Multi-ply	717	588	766	794	690	729	650
Facial tissue, excluding toweling, napkin, and toilet	277	298	370	376	383	365	359
Napkin	532	474	532	533	429	470	448
Single-ply	407	341	409	404	317	353	342
Multi-ply	125	133	123	129	112	117	106
Toweling, excluding wiper stock	1,433	1,253	1,439	1,482	1,375	1,388	1,326
Sanitary napkin stock wadding	113	116	103	98	87	73	73
Wiper stock, regular, facial, and wadding type	56	129	74	63	57	48	67
Other sanitary stock	94	114	74	78	76	96	91
Tissue paper	106	114	176	198	210	197	193
Wrapping tissue	(D)	(D)	72	83	75	74	61
Waxing tissue stock	(D)	(D)	24	31	32	28	37
Creped wadding for interior packaging	(D)	(D)	25	41	37	35	30
Other tissue, excluding sanitary and thin	21	25	18	21	29	28	30

Note: Categories shown are those now used by Bureau of the Census. Categories in older reports do not always correspond to the present ones.
r = Revised.
(D) Data withheld to avoid disclosing figures for individual companies.
(S) Suppressed because the data did not meet publication standards of the Bureau of the Census.
* "Book paper, uncoated, total." 1976—2,973,891 tons; 1975—2,401,131; 1974—2,831,562.
** "Writing and related papers, not included elsewhere, total." 1976—3,720,678 tons; 1975—3,244,141; 1974—4,101,606.
1. Reported as production by Bureau of the Census prior to 1981. Data no longer reported annually after 1989.
2. Forms bond included 1984 and 1985 only.
3. Excluding cotton-fiber, index, and bogus.
4. Cigarette, condenser, other.
5. Grocery bag and sack paper.
6. Other unbleached kraft bag paper.
Source: Bureau of the Census.

PRINTING/WRITING PAPER SHIPMENTS, 1982-89

(000 short tons)

Grade	1989	1988r	1987r	1986r	1985r	1984r	1983r	1982r
Total uncoated free-sheet[1]	11,081	11,277	10,976	10,410	9,690	9,152	8,726	7,809
Offset	2,628	2,918	2,819	2,634	2,469	2,396	2,210	2,018
Copy/duplicating (BMDX)	3,005	3,069	2,925	2,673	2,487	2,333	2,300	2,013
Forms bond	2,112	2,127	2,157	2,151	1,922	1,829	1,688	1,510
Carbonless	702	684	599	541	496	443	400	379
Envelope (white wove)	923	943	916	867	789	774	715	639
Envelope (bleached/unbleached kraft)	234	269	256	254	235	237	231	208
Tablet	367	379	425	412	443	299	406	345
Text and cover	442	349	329	310	289	299	276	235
Other	579	540	550	548	560	541	501	462
Total coated paper[1]	7,215	7,359	6,860	6,263	5,875	6,249	5,716	4,991
Coated one side[2]	415	423	422	385	360	390	392	365
Coated two side Nos. 1-4[2]	3,257	3,322	3,117	2,755	2,527	2,670	2,338	2,035
Coated two side No. 5[2]	3,543	3,614	3,321	3,123	2,988	3,189	2,985	2,591
Operating rates[2]								
Uncoated free-sheet	91.2%	95.1%	95.5%	94.4%	92.7%	91.0%	93.3%	86.4%
Coated groundwood	90.9	96.7	92.1	92.3	88.8	96.9	94.9	91.0
Coated free-sheet	85.9	91.8	94.4	93.6	87.2	93.1	96.0	89.8

r = Revised.

1. American Paper Institute.
2. *Pulp & Paper Week* estimates.

CANADIAN PAPER PRODUCTION

(000 short tons)

Year	Newsprint	Uncoated mechanical	Uncoated woodfree	Coated	Other printing/ writing[1]	Wrapping papers[2]	Tissue/ specialty	Building papers	Total*
1990	9,996	1,962	1,361	638	—	549	547	—	15,056
1989	10,626	1,849	1,161	541	—	579	536	—	15,303
1988	10,847	1,793	1,029	531	—	626	538	—	15,376
1987	10,615	1,492	955	511	—	625	503	—	14,710
1986	10,143	1,346	n.a.	n.a.	1,300	596	506	142	13,985
1985	9,799	1,157	n.a.	n.a.	1,205	537	493	138	13,284
1984	9,829	1,054	n.a.	n.a.	1,122	474	440	134	12,994
1983	9,275	1,046	n.a.	n.a.	1,168	520	424	155	12,196
1982	8,925	715	n.a.	n.a.	916	500	413	137	11,478
1981	9,861	883	n.a.	n.a.	880	540	428	130	12,640
1980	9,507	677	n.a.	n.a.	987	588	416	140	12,200
1979	9,652	624	n.a.	n.a.	1,008	646	408	138	12,259
1978	9,747	580	n.a.	n.a.	871	637	390	142	12,148
1977	8,988	463	n.a.	n.a.	759	571	365	155	11,146
1976	8,915	384	n.a.	n.a.	544	528	341	165	10,757
1975	7,679	311	n.a.	n.a.	437	429	298	161	9,186
1970	8,719	289	n.a.	n.a.	616	457	297	101	11,782

*May not total due to rounding.

n.a. = Not available.

1. After 1988 broken down into uncoated wood-free and coated.
2. Kraft papers.

Sources: Canadian Pulp & Paper Assn., *Pulp & Paper.*

VALUE OF SHIPMENTS OF PRIMARY PAPER PRODUCTS[1]

(million $)

	1989	1988	1987	1986	1985	1984	1983	1982	1981	1979
Newsprint	$2,952	$3,121	$2,737	$2,413	$2,393	$2,344	$2,122	$2,138	$2,187	$1,226
Uncoated groundwood	1,222	1,127	912	925	908	1,043	870	733	765	723
Publication/printing	1,024	951	809	804	832	901	—	—	—	—
Coated printing and converting	7,320	7,145	5,832	5,465	5,426	5,365	4,255	3,799	3,446	2,825
Coated groundwood	3,462	3,348	2,678	2,600	2,791	2,729	2,229	2,000	—	—
Coated free-sheet	3,858	3,797	3,153	2,865	2,635	2,636	2,026	1,799	—	—
Uncoated printing/writing[2]	9,923	9,611	8,044	7,423	6,704	6,959	5,985	5,463	5,660	4,666
Writing, chemical pulp	5,702	5,425	4,399	3,994	3,741	3,889	3,392	3,107	3,221	—
Publication/printing	2,436	2,465	2,164	2,054	1,687	1,784	1,516	1,414	1,521	—
Cover/text	672	621	531	453	468	466	362	320	277	—
Other	1,112	1,099	949	922	807	820	715	621	641	—
Cotton-fiber and thin	868	883	683	750	688	732	633	666	696	645
Bleached bristols	1,049	947	883	696	647	692	640	563	585	502
Unbleached kraft packaging[3]	1,619	1,491	1,222	1,102	1,090	1,331	1,190	1,151	1,343	1,244
Packaging and converting[4]	1,133	1,103	945	821	778	795	717	797	758	760
Special industrial	1,158	1,153	1,006	976	968	992	1,011	631	617	575
Tissue	6,058	5,139	4,571	4,213	4,593	4,019	3,977	3,679	3,550	2,618
Total[5]	**33,303**	**31,719**	**26,851**	**24,783**	**24,194**	**24,272**	**21,399**	**19,417**	**19,607**	**15,784**

1. Data no longer reported annually after 1989.
2. Uncoated free-sheet.
3. Plus industrial converting papers.
4. Except unbleached kraft.
5. Totals are higher than individual values due to inclusion of nonclassified grades.

Source: Bureau of the Census.

MARKET INDICATORS FOR PAPER GRADES: ESTIMATED ANNUAL U.S. ADVERTISING EXPENDITURES

(million $)

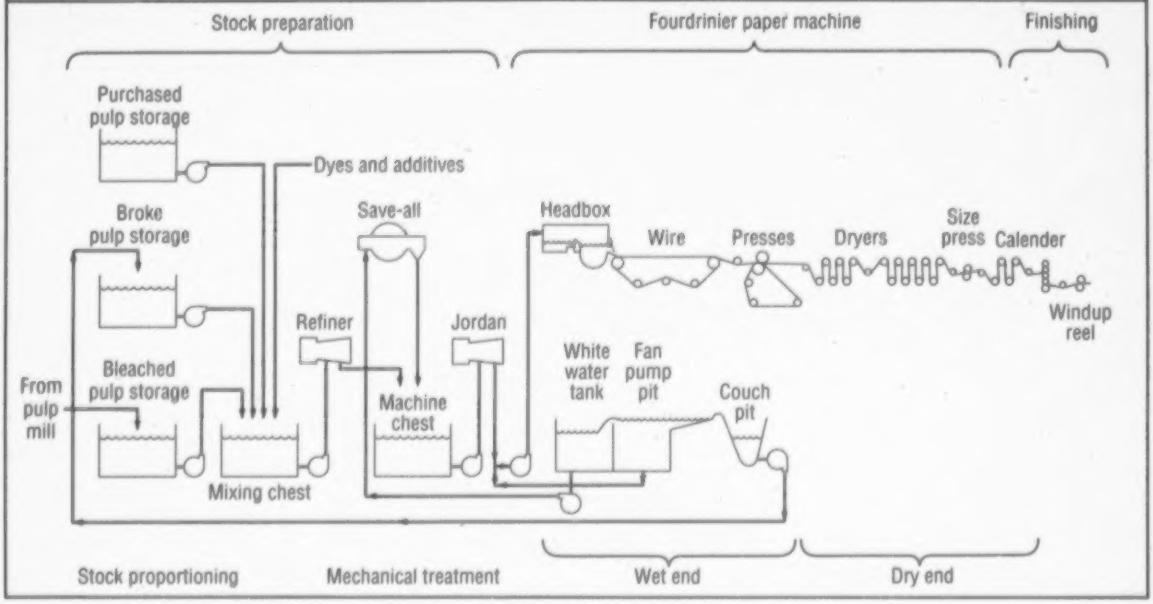
Year	Newspaper	Magazine	Television	Radio	Yellow pages	Direct mail	Total[1]
1990	$32,281	$6,803	$28,405	$8,726	$8,926	$23,370	$128,640
1989	32,368	6,716	26,891	8,323	8,330	21,945	123,930
1988	31,197	6,072	25,686	7,798	n.a.	21,115	118,050
1987	29,412	5,607	23,904	7,206	n.a.	19,111	109,650
1986	26,990	5,317	22,585	6,949	n.a.	17,145	102,000
1985	25,170	5,155	20,770	6,490	n.a.	15,500	95,000
1984	23,715	4,850	18,585	6,025	n.a.	13,480	n.a.
1983	20,582	4,233	16,136	5,210	n.a.	11,795	n.a.
1982	17,694	3,710	14,329	4,670	n.a.	10,319	n.a.
1981	16,528	3,533	12,650	4,230	n.a.	8,944	n.a.
1980	14,794	3,149	11,366	3,702	n.a.	7,596	54,000
1979	13,863	2,932	10,154	3,310	n.a.	6,653	n.a.
1978	12,214	2,597	8,955	3,052	n.a.	5,987	n.a.
1977	10,751	2,162	7,612	2,634	n.a.	5,164	n.a.
1976	9,618	1,789	6,721	2,330	n.a.	4,786	n.a.
1975	8,234	1,465	5,263	1,980	n.a.	4,124	28,000
1970	5,704	1,292	3,596	1,308	n.a.	2,766	20,000
1965	4,426	1,161	2,515	917	n.a.	2,324	15,000

n.a. = Not available.

1. Includes other expenditures.

Source: Prepared for *Advertising Age* by Robert J. Coen, McCann-Erickson.

TYPICAL FLOW DIAGRAM FOR A FINE PAPER MILL


Stock preparation
Fourdrinier paper machine
Finishing
Purchased pulp storage
Dyes and additives
Broke pulp storage
Save-all
Headbox
Wire
Presses
Dryers
Size press
Calender
Windup reel
Refiner
Jordan
White water tank
Fan pump pit
Couch pit
From pulp mill
Bleached pulp storage
Machine chest
Mixing chest
Stock proportioning
Mechanical treatment
Wet end
Dry end

MARKET INDICATORS, PRINTING AND PUBLISHING PAPERS: VALUE OF SHIPMENTS

(million $ current)[1,2]

Year	Newspapers SIC: 2711	Periodicals SIC: 2721	Book publishing SIC: 2731	Book printing SIC: 2732	Commercial printing SIC: 2751, 2752, 2754	Manifold business forms SIC: 2761
1991f	$36,611	$23,382	$17,250	$4,895	$58,930	$8,107
1990e	35,101	21,691	15,975	4,510	55,075	8,011
1989e	34,312	20,625	14,930	4,235	51,715	7,932
1988e	33,044	18,914	13,574	3,781	47,955	7,761
1987	31,849	17,329	12,620	3,256	44,731	7,359
1986	29,091	15,719	10,732	3,102	37,358	6,985
1985	27,015	15,246	10,196	2,919	35,559	6,669
1984	25,302	14,053	9,459	2,828	33,114	6,297
1983	24,050	12,943	8,475	2,600	28,785	5,195
1982	21,286	11,525	7,723	2,392	27,091	5,034
1981	20,050	9,843	6,760	2,556	23,149	4,735
1980	17,750	9,229	6,675	2,325	19,700	4,308
1979	16,125	8,240	6,040	2,100	18,200	3,846
1978	14,500	7,292	5,495	1,920	16,500	3,259
1977	12,966	6,077	4,882	1,696	14,800	2,884
1976	11,659	5,044	3,968	1,328	13,355	2,328
1975	10,433	4,380	3,537	1,241	11,691	2,185
1970	6,967	3,096	2,434	800e	7,865	1,233

f = Forecast.
e = Estimate.
1. Value for industry, including service.
2. Printing categories such as engraving and plate printing, greeting card publishing, blankbooks and loose-leaf binders, bookbinding work, typesetting, photoengraving, electrotyping, and platemaking services are not included but amounted to almost $7.2 billion in 1987.
Source: U.S. Dept. of Commerce: "U.S. Industrial Outlook 1990."

PRINTING/WRITING PAPER MILLS MAKING RECYCLED PAPER

Company	Mill	Capacity*	Wastepaper content (%)**	Recycled grades
Appleton Papers	West Carrollton, Ohio	350 tpd	50/10	Carbonless, thermal basestock
Badger Paper Mills	Peshtigo, Wis.	210 tpd	50/10	Copy, colored offset and copy
Beckett Paper[1]	Hamilton, Ohio	160 tpd	50/10	Writing, vellum opaque, text and cover
Boise Cascade	Vancouver, Wash.	180 tpd	50/10	Copy, offset, forms, tag, tablet, envelope
Champion International	Deferiet, N.Y.	605 tpd	30-50/10	Supercalendered, coated publication
	Hamilton, Ohio	530 tpd	50	Uncoated, coated free-sheet
CPM Inc.	Claremont, N.H.	40 tpd[2]	50-100	Kraft/white envelope, school construction
	East Ryegate, Vt.	60 tpd[2]	50-100	Envelope, other
Crane & Co.	Dalton, Mass.	30 tpd	85/15	Bond, 100% cotton bond
	Dalton, Mass. (Byron Weston Div.)	70 tpd	50(35 and 15)††	Bond and cover, 25% cotton
Cross Pointe[3]	West Carrollton, Ohio (Miami Paper)***	300 tpd	50-100/20-25	Book, text and cover, premium printing
	Park Falls, Wis. (Flambeau Paper)***	375 tpd	50/10	Book, text and cover premium printing
Daishowa[4]	Port Angeles, Wash.	400 tpd	40	Directory
	Quebec City, Que.***	1,345 tpd	40	Directory, newsprint, medium hi-bright groundwood
Domtar	St. Catharines, Ont.	250 tpd	45-100/5-100	Writing, envelope stock
Eastern Fine Paper	Brewer, Maine	180 tpd	50	25% cotton, offset, mimeo, copy
E.B. Eddy	Ottawa, Ont.	66 tpd	50/10+	Offset, copy, bond, text and cover, envelope, Reply card, poster paper, shopping bag
Esleeck Manufacturing	Turners Falls, Mass.	20 tpd	100/10	25% cotton
Exton Paper Mftrs.	Modena, Pa.	60 tpd	n.a.	Kraft for envelope, wrapping, etc.
Fletcher Paper	Alpena, Mich.	85 tpd	50/20	Offset using 20% deinked fiber
Fox River Paper	Appleton, Wis.	100 tpd	50-100/15-25[5]	Cotton, cover, opaque, typewriter
Fraser	Madawaska, Maine	1,266 tpd	10	Telephone directory paper
French Paper	Niles, Mich.	65 tpd	50/10	Copy, writing, cover and text
Georgia-Pacific	Kalamazoo, Mich.	400 tpd	50/10	Copy
	Nekoosa/Port Edwards, Wis.	440 tpd[6]	50/10	Copy
P.H. Glatfelter	Neenah, Wis.	400 tpd	50, 100/25, 50/1-2	Book, writing, envelope, film-coated offset
Hennepin	Little Falls, Minn.	80 tpd	40/25	Colored offset and copy, opaque color
Hopper Paper[7]	Taylorville, Ill.	100 tpd	50/40	Cover and text, writing
Howard Paper Mills	Dayton, Ohio	225 tpd†	50	Cover, text, bond, specialty
	Urbana, Ohio	†	50/10	Cover, text, bond, specialty
IP/Hammermill	Oswego, N.Y.	217 tpd	40, 50/10	Copy, cotton
	Westfield, Mass. (Strathmore Div.)	160 tpd[8]	25, 50, 50/25	Writing, text and cover, cotton
	Hoquiam (Grays Harbor), Wash.	375 tpd	50	Bond, offset

Continued

PRINTING/WRITING PAPER MILLS MAKING RECYCLED PAPER (continued)

Company	Mill	Capacity*	Wastepaper content (%)**	Recycled grades
IP/Hammermill	Merrill, Wis. (Ward/Strathmore Div.)	100 tpd	50, 50/20	Writing, colored offset and copy
Island Paper Mills	New Westminister, B.C.	400 tpd	50	Uncoated wood-free
James River	Adams, Mass.	35 tpd	50/10	Writing, text and cover
	Parchment, Mich.	400 tpd	50/10	Lightweight opaque
	Ypsilanti, Mich.	50 tpd	50/10	Writing, text and cover
	Berlin-Gorham, N.H.	800 tpd	50/10	Forms bond
	Groveton, N.H.	300 tpd	50/10	Text and cover
	Camas, Wash.	1,450 tpd	30-50/10[9]	Unbleached kraft copy, envelope paper
Kerwin/Riverside	Appleton, Wis.***	120 tpd	50/100	Writing bond, tablet, school construction
Kieffer Paper Mills	Brownstown, Ind.***	80 tpd	100 pc	Uncoated offset, envelope, bag papers
Kimberly-Clark	Neenah, Wis.	120 tpd	50-100/15	Premium writing, text and cover
	Whiting, Wis.	250 tpd	50-100/15	Premium writing, text and cover
Lyons Falls	Lyons Falls, N.Y.	220 tpd	50, 50/10	Offset, reply card, tablet, forms, other
MacMillan Bloedel	Port Alberni, B.C.	1,100 tpy	n.a.	Groundwood directory paper (December 1991)
Manistique Papers	Manistique, Mich.	250 tpd	100	Groundwood specialties
Mead	Chillicothe, Ohio	1,248 tpd	50/10	Copy
	Kingsport, Tenn.	550 tpd	50/10	Uncoated papers
	Menasha, Wis. (Gilbert Paper Div.)	100 tpd	50+	Fine printing and writing, cotton
Mohawk Paper	Cohoes and Waterford, N.Y.	200 tpd	60/10, 100/50	Offset, text and cover, coated text and cover
Niagara of Wisconsin[3]	Niagara, Wis.	700 tpd	34/5, 50+	Coated publication: 50-, 60-, 70-lb
Noranda Forest	Thorold, Ont.	320 tpd	50[10]	Book, forms, copy, envelope, tablet
Patriot Paper[11]	Boston, Mass.***	230 tpd	100/40/10	Copy, book, offset, cover
Potlatch	Cloquet, Minn.	550 tpd	50	Coated text and cover
Potsdam Paper Mills	Potsdam, N.Y.	185 tpd	40+	MF and MG opaque
Putney Paper	Putney, Vt.	36 tpd	up to 100	MG/MF printing, coated book, ledger, thin
Repap Wisconsin	Kimberly, Wis.	1,400 tpd	50/20	No. 4 coated groundwood
Rolland	St. Jerome, Que.	400 tpd	50-100/20	Uncoated woodfree
Scott/S.D. Warren	Westbrook, Maine	447 tpd	50/10	Coated text
Seaman Paper	Otter River, Mass	75 tpd	n.a.	Lightweight groundwood, specialty papers
Simpson Paper	Plainwell, Mich.	250 tpd	50, 40-50/10	Coated free-sheet, film coated
	Pomona, Calif.***	340 tpd	50, 50/10[12]	Copy, offset, opaque
	Ripon, Calif.	110 tpd	50, 50/10[12]	Text and cover, writing
	Vicksburg, Mich.	100 tpd	50-100[12]	Text and cover
	West Linn, Ore.	485 tpd	50, 40-50/10	Coated free-sheet, coated groundwood
	Miquon, Pa.	140 tpd	50/10	Text and cover, writing

Continued

PRINTING/WRITING PAPER MILLS MAKING RECYCLED PAPER (continued)

Company	Mill	Capacity*	Wastepaper content (%)**	Recycled grades
Specialty Coatings	Warren Glen, N.J.	75 tpd	50+	Cover
Stora Papyrus	Newton Falls, N.Y.	325 tpd	50, 50/10	Coated text and cover
Union Camp	Franklin, Va.	300 tpd	50	Copy, writing[13]
Watervliet	Watervliet, Mich.	160 tpd	50-85	Coated and uncoated book offset
Wausau Paper	Brokaw, Wis.	50 tpd	50/10	Writing, offset, text and cover
Valentine Paper	Lockport, La.	140 tpd	50	Offset, tablet, reply card
Westvaco	Tyrone, Pa.	200 tpd	50/10	Envelope paper, offset, coated offset
Weyerhaeuser	Plymouth, N.C.	940 tpd	50	Copy
	Longview, Wash. (R-W Papers Div.)	360 tpd	50	Copy
Geo. A. Whiting	Menasha, Wis.	28 tpd	90/10	Writing, cover and text
PROPOSED/IN PROGRESS				
Cascades/Steinbeis	East Angus, Que. or Niagara Falls, N.Y.	140 tpd	100	Uncoated office papers
International Paper	Lock Haven, Pa.***	725 tpd	50/10	Uncoated business papers
James River	Halsey, Ore.	300 tpd	n.a.	Pulp for printing/writing and tissue mills
Mi Ho Paper	St. Joseph, Mo.	350 tpd	50/100	Fine papers
Simpson Paper	Anderson, Calif.	420 tpd	n.a.	Coated publication
Westbrook Wood	Klamath Falls, Ore.	560 tpd	50	Lightweight coated
International Paper	n.a.	n.a.	n.a.	Coated groundwood by year-end 1991
CLOSED				
Performance Papers	Kalamazoo, Mich.	250-300 tpd	Closed	Book, other
G-P/Hopper	Reading, Pa.	60 tpd	Closed	Cover and text, writing
Sorg Paper	Middletown, Ohio	85 tpd	Converted	Converted to tissue, towel

*Total mill capacity. Many mills may produce only small amounts of recycled grades; a few are fully dedicated. Sources: Company data, *Lockwood-Post's Directory*, industry analysts.

**50/10 = total recycled fiber content/postconsumer, deinked, and/or postcommercial; 50-100 = up to 100% recycled; pc = postconsumer.

***Onsite deinking currently in progress.

† 225 tpd combined for both mills; includes nonrecycled grades. Minimum 5% postconsumer in some grades.

††Byron Weston Div.: 15% postconsumer deinked plus 35% secondary postconsumer.

n.a. = Not available or not applicable.

1. Division of Hammermill Papers/International Paper Co.
2. Estimated average: Claremont produces 40 tpd and East Ryegate 60 tpd operating five to six days a week.
3. Subsidiary of Pentair Inc. Proposed deinking mill at Flambeau.
4. 40% deinked newsprint fiber from 400 tpd onsite deinking plant at Quebec City; plans for deinking plant at Port Angeles.
5. 100% recycled: 10% to 15% postconsumer waste.
6. Less than 50,000 tpy recycled.
7. Separate operating company of Georgia-Pacific Corp.
8. Total of Turners Falls, Westfield, Woronoco, and Millers Falls mills.
9. 30% postindustrial unbleached kraft paper from converters.
10. 5% minimum postconsumer, 45% postcommercial. Other grades: coated label, coated one side packaging, wallpaper substrates, drawing, envelope, tablet, and register.
11. Installing deinking capacity.
12. 25%, 50%, and 50% plus 10% postconsumer.
13. Only a small amount of recycled made.

Additional Sources: *Pulp & Paper* estimates, E.H. Pechan & Assoc. Inc., Canadian Pulp & Paper Assn.

Paper:

NEWSPRINT

Newsprint is used primarily by newspaper publishers, with much of the remainder going to commercial printers for preprinted newspaper inserts and government printing jobs. The furnish is mostly mechanical pulp, with chemical pulp added to improve runability on paper machines and printing presses.

Most newsprint is now produced on twin-wire units, replacing the traditional fourdrinier. More than 75% of North American capacity is equipped with twin wires. These are either new machines or existing fourdriniers that have been rebuilt with twin wires (such as the Bel-Baie, Symformer, Verti Forma, Papriformer, Periformer, or Duoformer). One way to modify a fourdrinier is through the addition of a top former, which can be installed in as little as two days.

The first commercial gap formers to be used in newsprint production were installed in the late 1960s. These were the Vertiformer I and the Bel Baie I (considered the first blade formers) and the Papriformer (considered the first roll former). In the early 1970s, hybrids of the original gap formers, namely the Symformer and the Duoformer F, became available from European machine manufacturers.

A third generation of twin-wire forming that is now being built into new machines represents a quantum leap in this technology. It will allow newsprint in the nineties to be made on machines trimming at least 300 in. (7.6 m) and operating at speeds well above 3,281 fpm (1,000 m/min). In fact, machine speeds are expected to reach 5,900 fpm (1,800 m/min) by the year 2000, according to Nystrom, Lee, Kobayashi Inc. At the same time, newsprint quality targets will soon surpass the capabilities of slower twin-wire machines unless methods unrelated to the wet end design of the paper machine are implemented (e.g., use of fillers and soft calendering).

Newsprint produced on twin-wire machines has better sheet characteristics and less two-sidedness than that produced on traditional fourdriniers. Twin wires also enhance productivity, as marginal speedup results from faster drainage on some machines.

In 1982, the startup of *USA Today*, a Gannett daily national newspaper, fostered the use of twin-wire newsprint, which enables publishers to make better use of four-color printing. Further, the advent of widespread mandated recycling—and the development by Southeast Paper Manufacturing Co. of a recycled sheet that meets *USA Today* specifications—are forcing most manufacturers to develop sheets that offer competitive printability and runability while incorporating some recycled fiber in the furnish.

Newsprint in the U.S. usually comes in a standard basis weight of 30 lb/3,000 ft^2 (48.8 g/m^2). The American Newspaper Publishers Assn. (ANPA) conducts an annual newsprint testing program, which in 1990 tested samples from

STATISTICS FOR NEWSPRINT[1]

	1991e	1990	1989	1988
U.S.				
Production, 000 tons	6,575	6,610	6,088	5,982
Capacity, 000 tons	7,148	6,828	6,296	6,115
Utilization rate, %	92.0	96.8	96.7	97.8
Apparent U.S. consumption				
000 tons	12,698	13,366	13,494	13,498
lb/capita	101.3	108.3	108.7	109.8
000 tons/billion $ real GNP	3.07	3.22	3.26	3.35
CANADA				
Production, 000 tons	9,695	9,996	10,626	10,847
Capacity, 000 tons	11,276	11,100	11,045	10,962
Utilization rate, %	86.0	90.1	96.2	99.0

e = Estimate.
1. All tons are short tons.
Source: *Pulp & Paper.*

59 mills. Of those mills, 53 submitted samples identified as 30 lb and 32 submitted samples with nominal weights below 30 lb.

At one point in the mid-1980s, it appeared that publishers preferred a somewhat lighter-weight standard—usually between 27 lb and 29 lb, but that never became a general movement. Indeed, by 1991, only Georgia-Pacific Corp. was producing the majority of its output at some basis weight other than 30 lb; a great deal of its production was 28-lb paper (45.6 g/m^2) so its average was between 28 lb and 30 lb. Newsprint is available in standard basis weights as low as 24 lb (39.5 g/m^2) and as high as 35 lb (56.9 g/m^2). Prior to 1974, the standard basis weight was 32 lb (52.1 g/m^2), but it was reduced to trim costs and conserve fiber.

Because three major printing methods are used by consumers of newsprint, paper manufacturers vary sheet surface qualities, including basis weight, opacity, and brightness. However, the choice of printing methods is narrowing to two—offset and flexographic—because printing quality standards have outpaced the abilities of letterpress to compete with those methods.

In 1970, letterpress accounted for virtually all newspaper printing. By 1990, offset-printed newspapers represented 85% of all press units and 78% of total U.S. daily circulation, according to ANPA. Letterpress and combined methods accounted for 11% of press units and 20% of circulation, and flexo accounted for the balance.

An estimated 36 daily newspaper printing plants in the U.S. were equipped with at least some flexo press units in 1991, with the largest being newspapers in Providence, R.I., and San Francisco and Long Beach, Calif. However, it is believed that only one newspaper placed an order for flexo units between mid-1990 and mid-1991, and that was for add-ons to an existing press. The largest orders in recent years have been for offset presses, with metropolitan dailies investing hundreds of millions of dollars in top-quality color capability.

Offset quality has been better than flexo; however, flexo has significant cost advantages and uses water-base inks that do not rub off. Newsprint must be highly water resistant and lint free in order to be used on flexo presses.

Most newsprint is not sized, apart from the addition of alum at the grinders to prevent resin buildup. Fillers are not generally needed due to the high opacity of groundwood pulp. Bleaching is done with peroxides or hydrosulfites, giving a final brightness of about 57 to

GROWTH OF NORTH AMERICAN CAPACITY BY AREA

(000 metric tons)

U.S.

Year	Northwest/ Midwest	South	West	Total
1993p	718	3,856	2,166	6,740
1992p	720	3,828	2,107	6,655
1991p	716	3,793	1,976	6,485
1990r	716	3,609	1,884	6,195
1989r	720	3,253	1,737	5,710
1988	695	3,127	1,728	5,550
1987	654	3,084	1,712	5,450
1986	648	2,967	1,700	5,315
1985	650	2,958	1,692	5,300
1984	594	3,051	1,660	5,305
1983	576	2,978	1,681	5,235
1982	584	2,940	1,606	5,130
1981	592	2,918	1,440	4,950
1980	633	2,627	1,160	4,420
1979	609	2,205	996	3,810
1978	670	2,080	960	3,710

CANADA

Year	Quebec	Ontario/ Manitoba	British Columbia	Atlantic	Total
1994p	4,512	2,633	2,117	1,763	11,025
1993p	4,494	2,631	2,107	1,758	10,990
1992p	4,477	2,607	2,090	1,751	10,925
1991p	4,425	2,350	1,960	1,695	10,430
1990r	4,342	2,111	1,914	1,733	10,100
1989	4,458	2,068	1,758	1,736	10,020
1988	4,537	2,066	1,631	1,711	9,945
1987	4,498	2,076	1,608	1,674	9,856
1986	4,390	2,060	1,595	1,755	9,800
1985	4,404	2,040	1,630	1,650	9,724
1984	4,305	2,090	1,710	1,605	9,710
1983	4,452	2,045	1,770	1,620	9,887
1982	4,580	1,980	1,710	1,665	9,935
1981	4,495	1,985	1,440	1,570	9,490
1980	4,308	1,985	1,352	1,485	9,130
1979	4,251	1,972	1,395	1,445	9,063
1978	4,263	1,920	1,370	1,429	8,982

p = Preliminary.
r = Revised.
Source: Canadian Pulp & Paper Assn., Newsprint Data.

60 in contrast to the 60 to 65 brightness range preferred for higher grades of uncoated groundwood paper, such as groundwood offset.

Although the furnish used for newsprint is still primarily groundwood, thermomechanical pulp (TMP) and chemithermomechanical pulp (CTMP) have become more commonplace. In many mills, TMP is used to replace some chemical pulp, which typically supplies 10% to 15% of newsprint furnish. With its longer fibers, chemical pulp makes a stronger sheet. Unbleached softwood sulfite pulps are used more commonly in Canada than in the U.S., where semibleached sulfate softwood pulp is preferred. TMP is weaker than chemical pulp but stronger than groundwood, and it costs less than chemical pulp. Secondary fiber also is used in some newsprint furnishes.

Approximately 27%, or 4.5 million metric tpy, of total North American newsprint capacity was expected to use wastepaper as a raw material by the end of 1991. Waste newspapers are deinked and added to other types of pulp or used alone. Garden State Paper Co. was the pioneer in this field. The company's flagship mill is in Garfield, N.J., and GSP's parent, Media General Inc., has interests in two other recycled newsprint mills in Dublin, Ga., (Southeast Paper Manufacturing) and San Luis Potosi, Mexico. In addition, its patented process is licensed to the Pomona, Calif., mill of Smurfit Newsprint Corp. and FSC Paper Co.'s Alsip, Ill., mill.

Recycled newsprint mills use furnish that consists of up to 100% deinked newspapers, which tend to be plentiful in the urban areas where mills are located. Some mills also use coated magazine stock for up to 30% of their fiber. In

NORTH AMERICAN RECYCLED NEWSPRINT PRODUCERS, 1991*

Company	Mill	Capacity (metric tpy)	Recycled content
U.S.			
Augusta Newsprint	Augusta, Ga.	363,000	Var.
Calhoun Newsprint	Calhoun, Tenn.	220,000[1]	Var.
FSC Paper	Alsip, Ill.	122,000	100%
Garden State Paper	Garfield, N.J.	201,000	100
Inland Empire	Millwood, Wash.	66,000[2]	40
Manistique	Manistique, Mich.	56,000	100
North Pacific Paper	Longview, Wash.	700000[3]	Var.
Smurfit	Newberg, Ore.	357,000	50
	Oregon City, Ore.	220,000	50
	Pomona, Calif.	122,000	100
Southeast Paper	Dublin, Ga.	378,000	100
Stone Container	Snowflake, Ariz.	275,000	55
CANADA			
Atlantic Packaging	Whitby, Ont.	150,000[4]	100
CPFP	Gatineau, Que.	440,000[5]	Var.
	Thunder Bay, Ont.	240000[6]	Var.
Fletcher Challenge	Crofton, B.C.	150,000[7]	Var.
MacMillan Bloedel	Port Alberni, B.C.	75,000[7]	Var.
	Powell River, B.C.	75,000[7]	Var.
Quebec & Ontario	Thorold, Ont.	306,000	55

*For deinking capacity starting up after 1991, see table "North American Deinked Newsprint Projects, 1990-94."

Var. = Recycled content will vary.

1. Owned by Bowater Inc. (51%) and Advance Publications Inc. (49%). New 109,500-tpy deinking line scheduled to start up in late 1991.
2. New 37,000-tpy deinking line scheduled to start up in late 1991.
3. New 156,000-tpy deinking line added in May 1991.
4. New 150,000-tpy machine started up in December 1990.
5. New 180,000-tpy deinking line scheduled to start up in late 1991.
6. New 100,000-tpy deinking line scheduled to start up in late 1991.
7. Fletcher Challenge Canada Ltd. and MacMillan Bloedel Ltd.'s mills will be supplied with recycled fiber from Newstech Recycling Corp's new 122,000-tpy market deinked pulp mill in Vancouver, B.C., which was scheduled to start up in late 1991.

Sources: Newsprint Information Committee, *Pulp & Paper Week*, *Paper Recycler*.

U.S. NEWSPRINT CAPACITY AND PRODUCTION

(000 short tons)

Year	Capacity	Production	Operating rate
30-lb weight			
1993p	7,430	—	—
1992p	7,335	—	—
1991p	7,151	—	—
1990	6,828	6,610	—
1989	6,296	6,088	97%
1988	6,115	5,982	98
1987	6,006	5,842	97
1986	5,804	5,630	97
1985	5,788	5,428	94
1984	5,851	5,539	95
1983	5,774	5,167	89
1982	5,654	5,042	89
1981	5,457	5,239	96
1980	4,836	4,672	97
1979	4,199	4,062	97
1978	4,104	3,768	92
1977	4,069	3,871	95
1976	4,014	3,736	93
1975	3,848	3,691	96
1974	3,722	3,561	96
32-lb weight			
1974*	3,889	3,690	95
1973	3,819	3,738	98
1972	3,694	3,656	99
1971	3,642	3,476	95
1970	3,533	3,464	98
1969	3,374	3,362	100
1968	3,176	3,045	96
1967	2,844	2,709	95
1966	2,545	2,483	98
1965	2,372	2,245	95

*Adjusted to 32-lb equivalent basis weight.

p = Preliminary.

Sources: Canadian Pulp & Paper Assn., American Paper Institute.

cases where the furnish is not totally wastepaper based, deinked newsprint is combined with groundwood mechanical pulp or TMP. The mix varies widely according to fiber availability and the mill's specific cost structure.

The quality of recycled newsprint has improved steadily with better technology, making it comparable to virgin sheets in many pressrooms. In 1989, ANPA's Technical Dept. tested 1,861 samples of newsprint from 58 newspaper mills. About 15% of the samples were recycled newsprint. The 1989 results showed no significant optical or physical differences between recycled newsprint and virgin newsprint. (In 1990, ANPA tested a slightly larger number of samples from 59 mills but did not publish an evaluation of the differences between virgin fiber and recycled fiber; however, independent observers saw no reason for the 1989 results to change.)

ANPA conducts tests for moisture, grammage, caliper, roughness (using Parker PrintSurf), printability (for letterpress sheets only), tear, opacity, brightness, and color (using the L*A*B* system). It does not test for linting since no meaningful lint test has been developed that can be addressed by ANPA's equipment. The preferred characteristics in 1990 were moisture content of 7.5% to 8.5%, basis weight for 30-lb paper of 29.6 lb to 30 lb, Larocque print quality number of 68 points or higher, ISO brightness of at least 59%, an L* value of 83.7 or higher, and printing opacity of at least 94%. Other characteristics do not have an identified preference in the ANPA program.

Gannett began experimenting with the use of recycled newsprint for *USA Today* in 1988, probably compelled by the increasing political pressure placed on publishing companies to use recycled newsprint. In 1990, it followed this up by printing *USA Weekend* on recycled newsprint from Hylte Bruks AB's mill in Sweden. Gannett, Knight-Ridder, Times Mirror, and Scripps Howard are among the major newspaper publishers that have committed to using increasing amounts of recycled newsprint in the future. In 1990, ANPA asked its members to voluntarily increase their use of recycled newsprint from 14% to 28% of their total consumption by 1992.

Kenaf, a fast-growing, nonwood, fibrous plant, also is being looked at as a fiber source for newsprint. Extensive studies have been done on newsprint made from kenaf by ANPA and the U.S. Dept. of Agriculture. Efforts were subsequently taken up by Kenaf International and, for a time, Canadian Pacific Forest Products Ltd. KI includes the *Bakersfield Californian*, Agrifuture Inc., Bechtel Corp., Sequa Corp. and Werdell Ventures.

KI originally planned to construct a 215,000-tpy mill near McAllen, Texas, by 1991 but later decided to build a scaled-down, 30,000-tpy version of the mill at the same site. The downturn in the newsprint market then caused a postponement in the start of construction, but the company still says it plans to go ahead when conditions improve. KI says it has successfully run trials using a 50:50 blend of kenaf fiber and deinked wastepaper and now anticipates designing its initial mill for that kind of furnish. Newsprint South Inc. has also considered adding kenaf to its TMP furnish to produce newsprint at its Grenada, Miss., mill.

U.S. CONSUMPTION OF NEWSPRINT

(000 short tons)

Year	Consumption	Shipments from			Consumer stocks[1]
		U.S.	Canada	Others	
30-lb weight					
1990r	13,366	6,151	7,080	181	1,368
1989r	13,494	5,545	7,442	223	1,327
1988r	13,498	5,548	7,704	303	1,614
1987r	13,562	5,540	7,795	389	1,556
1986r	13,088	5,266	7,355	330	1,392
1985r	12,684	5,123	7,267	366	1,530
1984r	12,510	5,299	7,165	208	1,457
1983r	11,606	4,860	6,580	74	1,295
1982r	11,129	4,686	6,155	46	1,387
1981	11,204	4,907	6,682	41	1,628
1980	11,120	4,473	6,744	138	1,202
1979	11,240	3,970	7,023	146	967
1978	10,872	3,674	7,102	0	1,070
1977	10,232	3,737	6,341	0	1,181
1976	9,611	3,632	6,251	57	1,333
1975	9,254	3,566	5,489	33	1,004
1974	10,284	3,457	6,949	213	1,170
32-lb weight					
1974*	10,685	3,582	7,239	213	1,248
1973	10,794	3,657	6,855	381	782
1972	10,547	3,549	6,430	328	784
1971	9,835	3,307	6,146	317	1,041
1970	9,706	3,316	6,163	314	1,110
1969	9,855	3,246	6,431	293	1,017
1968	9,327	2,944	6,107	284	894
1967	9,238	2,612	6,263	283	885

*Adjusted to 32-lb equivalent basis weight.

r= Revised. (Canadian newsprint statistics were revised from 1982 onward to adjust for some supercalendered and soft-nip calendered paper, which was incorrectly classified as newsprint instead of uncoated mechanical printing paper.)

1. Based on data from American Newspaper Publishers Assn.

Source: Canadian Pulp & Paper Assn.

In summer 1987, CPFP produced about 85 short tons of newsprint from kenaf pulp at its Trois Rivières, Que., mill. The newsprint was tested at several southwestern newspapers and was considered to be stronger and whiter, requiring less ink and yielding brighter colors than regular newsprint. Because it contains no lignin, the paper will not yellow. According to KI, a kenaf sheet also has a harder surface than a woodpulp sheet, providing for equal or better color printing with reduced ink consumption. Other advantages are lower production costs and less pollution.

INDUSTRY STRUCTURE

Canada and the U.S. together produce almost half of the world's supply of newsprint. Canada manufactures about 30% of world supply and the U.S. over 17%. Aside from Japan (10% of world output), no other nation produces more than 7%. The U.S. is the world's leading consumer of newsprint, using 38% of global supplies. The nearest rival is Japan, which consumes just over 11%.

Canada is the world's leading producer and exporter of newsprint. It consumes only about 12% of its own production; the remainder accounts for nearly 60% of global exports. Canada's leading customer is the U.S., which received over 80% of the newsprint exported by Canada in 1990. Canadian newsprint represented about 53% of U.S. consumption that year (vs 66% in 1978).

The U.S. newsprint industry contributed 46% of total domestic consumption in 1990, compared with 34% in 1978 and 42% in 1989—an astonishing 4% jump in just one year. U.S. newsprint imports from countries other than Canada advanced rapidly to 352,900 metric tons in 1987 from 67,000 tons in 1983. However, they dropped to 201,000 tons in 1989 and 159,500 tons in 1990, mainly because currency exchange rates made imports less competitive in the U.S. and U.S. domestic capacity increased, taking a greater share of the North American market.

Canada still has the bulk of North American newsprint capacity: 62% in 1990. However, the U.S. has experienced the greatest growth in capacity during the past decade. Between 1980 and 1990, U.S. capacity increased 40%, while Canadian capacity rose only 11%.

Capacity increases in both countries slowed considerably in the mid-1980s to allow demand to catch up with the expansion that came earlier in the decade. Several older machines, particularly in Canada, were shut down or converted to higher-value groundwood specialties in the mid- to late 1980s.

Then in 1989-90, the North American industry entered yet another round of capacity expansion. Between 1989 and 1991, 12 new newsprint machines with 2.4 million metric tons of annual capacity were scheduled to come online. Announced Canadian newsprint capacity will move up 10.5% (1.1 million metric tons) between 1988 and 1993, while

CANADIAN CAPACITY, PRODUCTION, AND SHIPMENTS OF NEWSPRINT

(000 short tons)

Year	Capacity[1]	Production	Operating rate (%)	Change in capacity	Change in production	Shipments
30-lb weight						
1991e	11,497	—	—	—	—	—
1990	11,100	9,996	90%	55	-630	10,003
1989	11,045	10,626	96	83	-220	10,590
1988	10,962	10,847	99	99	231	10,736
1987	10,863	10,615	98	61	472	10,712
1986	10,803	10,143	94	83	344	10,157
1985	10,720	9,799	91	17	-30	9,809
1984	10,703	9,829	92	-193	554	9,835
1983	10,896	9,275	85	-39	349	9,224
1982	10,935	8,925	82	474	-940	8,865
1981	10,461	9,866	94	397	358	9,829
1980	10,064	9,507	94	72	-143	9,504
1979	9,992	9,651	97	131	-62	9,677
1978	9,861	9,713	98	-41	725	9,792
1977	9,902	8,988	91	-19	73	9,005
1976	9,921	8,915	90	29	1,218	8,712
1975	9,892	7,697	78	-146	-1,851	7,728
1974	10,038	9,548	95	—	—	9,597
32-lb weight						
1974[2]	10,474	9,946	95	137	806	9,998
1973	10,337	9,140	88	37	320	9,199
1972	10,300	8,820	86	60	365	8,901
1971	10,240	8,455	83	395	-264	8,362
1970	9,845	8,719	89	170	-99	8,704
1969	9,675	8,818	91	20	787	8,797
1968	9,655	8,031	83	361	-20	8,096
1967	9,294	8,051	87	416	-368	7,968
1966	8,878	8,419	95	457	699	8,385
1965	8,421	7,720	92	147	419	7,747

e = Estimate.

1. Tonnage data for 1965-74 are based on 32-lb weight newsprint; those for 1974-77 are measured in terms of 30-lb basis weight.

2. Adjusted to 32-lb equivalent basis weight.

Source: Canadian Pulp & Paper Assn.

U.S. capacity will grow by 21.5% (1.2 million tons), according to Canadian Pulp & Paper Assn. and American Paper Institute surveys. In addition to the 12 new machines, some machines were modernized during the period, producing some increase in capacity; but other units were also shut down or converted to other grades, for a net North American increase of 2.3 million tons.

Substantial as these capacity increases are, in the case of Canada they are quite a bit less than previously expected—in fact, about half of what had been predicted as recently as early 1990. A combination of several factors caused Canadian capacity projections to be revised significantly:

1. Slumping U.S. consumption (1991 is projected to be the fourth year in a row of declining usage) hurt Canadian mills more than their U.S. competitors since exchange rate developments plus lower U.S. costs and proximity to market allowed U.S. mills to capture market share from their Canadian competitors.

2. The need to invest in deinking facilities hit the Canadians, with their higher costs, harder than the U.S. industry. New virgin capacity suffered as a result.

3. Even in the middle of the capacity boom, several Canadian suppliers shut down machines (including Abitibi-Price Inc.'s entire Thunder Bay Div. plus one machine at its Grand Falls, Nfld., mill and two old machines at Canadian Pacific Forest Products' Thunder Bay, Ont., mill) or upgraded them to groundwood (Kruger Inc. at Trois Rivières).

The planned 1.1-million-ton Canadian increase may be reduced further due to pressure on operating margins from the market slump of 1990-91. Some observers think 1991 Canadian capacity will be 200,000 tons or more below levels estimated in mid-1991 by CPPA, while 1992 capacity may fall 500,000 tons or more from mid-1991 projections.

At one time or another, various companies were considering major newsprint expansions or greenfield mills for some time in the early 1990s. Among them were Bear Island Paper Co., Ashland, Va.; Donohue Inc., Amos, Que.; Normick/Forex, Val-d'Or, Que.; Westbrook Wood Products, Medford, Ore.; Daishowa America Co. Ltd., Port Angeles, Wash.; Stora Forest Products Ltd., Port Hawkesbury, N.S.; and Cascades Inc., Port Cartier, Que. Several of these were intended to include some deinking capacity. In addition, at least one recycled newsprint mill was planned. Jefferson Smurfit Corp. had narrowed down selection of a site somewhere in New York state for its 250,000-metric-tpy greenfield mill.

However, with the depressed state of the market in 1991, most major expansion plans—particularly those involving virgin fiber—were put on hold. It appears likely that an increasing proportion of the industry's capital investments will be related to recycling for several years to come.

NEW NORTH AMERICAN NEWSPRINT MACHINES SINCE 1980

Company	Location	Capacity (000 short tpy)	Startup
Bear Island Paper	Ashland, Va.	175	1980
Boise Southern	DeRidder, La.	192	1980
MacMillan Bloedel	Powell River, B.C.	176	1981
Smurfit Newsprint	Newberg, Ore.	210*	1981
North Pacific Paper	Longview, Wash.	210	1981
Fletcher Challenge	Crofton, B.C.	193	1982
Fletcher Challenge	Campbell River, B.C.	193	1982
Donohue-Normick	Amos, Que.	175	1982
Quebec & Ontario Paper	Thorold, Ont.	171*	1982
Quebec & Ontario Paper	Thorold, Ont.	171*	1982
Abitibi-Price	Iroquois Falls, Ont.	209	1983
Abitibi/Augusta Newsprint	Augusta, Ga.	226	1983
Canadian Pacific Forest Products	Gatineau, Que.	175	1987
Donohue	Clermont, Que.	198	1987
Fletcher Challenge	Mackenzie, B.C.	198	1989
Gold River Newsprint	Gold River, B.C.	254	1989
Newsprint South	Grenada, Miss.	224	1989
Southeast Paper	Dublin, Ga.	237*	1989
Ponderay Newsprint	Usk, Wash.	231	1989
Alabama River	Claiborne, Ala.	243	1990
Alberta Newsprint	Whitecourt, Alta.	243	1990
Atlantic Packaging	Whitby, Ont.	165*	1991
Kruger	Trois Rivières, Que.	198	1991
Canadian Pacific Forest Products	Thunder Bay, Ont.	265	1991
Howe Sound Pulp & Paper	Port Mellon, B.C.	220	1991
North Pacific Paper	Longview, Wash.	253*	1991

*Recycled newsprint machines.
Sources: *Pulp & Paper Project Report*, *Pulp & Paper Week*

Recycling. Mounting concern about solid waste in major North American cities, particularly in the U.S., has inspired lawmakers to draft measures to expand markets for recycled newsprint. The logic is that more old newspapers will be diverted from the solid waste stream and into deinking plants if greater demand can be created for wastepaper.

According to Kevin Grant, ANPA manager of state affairs, approaches tend to follow four patterns:

1. Mandating markets, with goals set over a certain period

2. Taxing virgin materials as a disincentive to production and demand

3. Offering tax incentives to spur production and demand

4. Implementing take-back schemes to get publishers to collect their own newspapers.

Since Florida passed the first mandatory recycled newsprint usage bill in late 1988, many other states have proposed or adopted similar bills. By late 1989, California and Connecticut had passed laws requiring publishers to consume a certain portion of recycled newsprint, and Wisconsin was close to adopting its own version of those laws. Wisconsin passed its bill in 1990 and was followed that year by Arizona, Illinois, Maryland, and Missouri, who adopted similar bills. Whether or not these states' goals can be met within the time frames mandated is questionable.

Some observers believe that voluntary agreements might be the new trend. API noted in mid-1990 that 15 proposals had "died or [were] being held in committee pending the outcome of negotiated voluntary agreements." By mid-1991, voluntary agreements had been worked out between state associations of publishers and state government officials in Iowa, Louisiana, Maine, Massachusetts, Michigan, New Hampshire, New York, Pennsylvania, Vermont, and Virginia.

Florida, the pacesetter with these bills, has imposed on state publishers a minor tax of 10¢ for every ton of virgin newsprint used exceeding half of total consumption. The tax will rise to 50¢/ton by 1992 if certain goals are not reached. Connecticut was the first state to set goals rather than penalties for using recycled-content newsprint.

Meanwhile, Wisconsin proposed a law late in 1989 focusing on the total amount of recycled fiber consumed as a proportion of total newsprint used statewide rather than measuring each publisher's recycled-fiber consumption.

One of the biggest concerns has been establishing a clear definition of recycled newsprint. Although many states have followed the Environmental Protection Agency's definition, which includes a requirement of 40% recycled-fiber content, many publishers and newsprint mills are opposed to this blanket approach. They note that credit is not given for using lower recycled-content newsprint, even though a newspaper might use it for all consumption rather than the 50%-or-lower goals set by some states.

Although nearly every newsprint producer in North

U.S. RECYCLED NEWSPRINT LAWS, BY STATE

State	Consumption goal[1]	Timetable
Arizona	25% 50	1991 2000
California	25 50	1991 2000
Connecticut	11* 50*	1992 1999
Florida	—	—[2]
Illinois	22* 28*	1991 1993[4]
Iowa	10* 40*	1991[3] 2000[3]
Louisiana	10* 40*	1992[3] 2000[3]
Maine	25 40	1993[3] 1995[3]
Maryland	12* 40*	1992 1998
Massachusetts	12% 50	1991[3] 2000[3]
Michigan	12 24	1992[3] 1995[3]
Missouri	10 50	1993 2000
New Hampshire	11 40	1993[3] 2000[3]
New York	11* 40*	1992[3] 2000[3]
Pennsylvania	35-50	1995[3]
Vermont	11* 40*	1992[3] 2000[3]
Virginia	15 30	1992[3] 1995[3]
Wisconsin	10 45	1992 2001

Note: table does not include preference purchasing provisions for government agencies.
*Secondary fiber requirement as percentage of total fiber used.
1. Recycled newsprint as percentage of total purchases (usually 40% recycled content) unless otherwise specified. Ranges imply goals to be phased in between those dates.
2. Per-ton tax is imposed on all virgin-fiber newsprint used in Florida.
3. Voluntary guidelines.
4. If goals are met by 1993, the law will be repealed.
Source: American Newspaper Publishers Assn.

MAJOR CHANGES IN NORTH AMERICAN NEWSPRINT CAPACITY, 1989-94

Company	Mill	Capacity (000 metric tpy)	Startup date	Comments
Announced				
Abitibi-Price	Alma, Que.	(55)[1]	Jan. 1989	Grade conversion
Donohue	Clermont, Que.	(40)	Feb. 1989	Paper machine shutdown
St-Raymond Paper	St. Raymond, Que.	(30)	May 1989	Mill closure
Finlay Forest[2]	Mackenzie, B.C.	180	Mar. 1989	New paper machine
MacMillan Bloedel	Powell River, B.C.	(40)	Aug. 1989	Paper machine shutdown
Gold River[3]	Gold River, B.C.	230	Nov. 1989	New paper machine
Newsprint South[4]	Grenada, Miss.	203	Jul. 1989	New mill
Southeast Paper Manufacturing	Dublin, Ga.	215[5]	Sep. 1989	New paper machine
Ponderay Newsprint[6]	Usk, Wash.	210	Nov. 1989	New mill
Stone-Consolidated	Shawinigan, Que.	(45)	Dec. 1989	Paper machine shutdown
Bowater Mersey	Brooklyn, N.S.	50	Dec. 1989	Paper machine speedup
Abitibi-Price	Kenogami, Que.	(30)	Jan. 1990	Paper machine shutdown
Abitibi-Price	Grand Falls, Nfld.	(60)	Mar. 1990	Paper machine shutdown
Alabama River[7]	Claiborne, Ala.	220	Jul. 1990	New mill
Alberta Newsprint[8]	Whitecourt, Alta.	220	Aug. 1990	New mill
Stone-Consolidated[9]	Grand'Mère, Que.	(70)[10]	Sep. 1990	Paper machine shutdown
Atlantic Newsprint	Whitby, Ont.	136[5]	Dec. 1990	New mill
Kruger	Trois Rivières, Que.	110[11]	Jan. 1991	New paper machine
Kruger	Trois Rivières, Que.	35	Mar. 1991	Paper machine shutdown
Stone-Consolidated	Trois Rivières, Que.	(62)	Early 1991	Paper machine shutdown
Abitibi-Price	Thunder Bay, Ont.	170	Apr. 1991	Paper machine shutdown
Howe Sound Pulp & Paper[12]	Port Mellon, B.C.	200	Apr. 1991	New paper machine
Canadian Pacific Forest Products	Thunder Bay, Ont.	60 (net)[13]	May 1991	New paper machine
North Pacific Paper	Longview, Wash.	230[5]	Sept. 1991	New paper machine
Donohue	Clermont, Que.	40	Jan. 1992	Paper machine shutdown
Proposed				
Garden State Paper	Northeast U.S.	n.a.[5]	n.a.	New mill
Smurfit Newsprint	Northeast U.S.	255[5]	n.a.	New mill
Steinbeis Group	East U.S. or Canada	n.a.[5]	n.a.	New mill
Bear Island	Ashland, Va.	200	n.a.	New paper machine
Donohue	Amos, Que.	200	n.a.	New paper machine
Smurfit Newsprint	Newberg, Ore.	275[5]	n.a.	New paper machine
Westbrook Wood Products	Medford, Ore.	n.a.[14]	n.a.	New mill
Daishowa America	Port Angeles, Wash.	200	1992e	New paper machine
Cascades	Port Cartier, Que.	225[5]	n.a.	New paper machine
Kenaf Paper	Raymondville, Tex.	30[15]	n.a.	New mill
Bowater	Arkadelphia, Ark.	n.a.	n.a.	New mill
MacMillan Bloedel/Haindl Papier	Central Valley, Calif.	284[5]	1994	New mill
Ponderosa Fibres	Albany, N.Y.	105[5]	1993-94	New mill
	Bronx, N.Y.	95[5]	1993	New mill

*New newsprint machines.
n.a. = Not available.
e = Estimate.
1. Conversion to directory paper.
2. Subsidiary of Fletcher Challenge Canada Ltd.
3. New company consisting of major shareholder Canadian Pacific Forest Products Ltd. (CP Forest) and seven partners.
4. Owned by Mississippi Chemical Co.
5. Recycled newsprint.
6. Partnership between CP Forest and five publishers.
7. Fifty-fifty joint venture of Abitibi-Price Inc. and Parsons & Whittemore Inc.
8. Investor group headed by Vancouver, B.C., businessman Ronald Stern in partnership with unidentified private Canadian companies.
9. Formerly Consolidated-Bathurst Ltd. Acquired by Stone Container Corp. in 1989.
10. Nos. 8 and 9 newsprint machines to be shut down when groundwood papers machine starts up in mid-1990.
11. Company-wide newsprint capacity increase will be lower due to conversion of 70,000-tpy newsprint machine at Corner Brook, Nfld., to supercalendered paper.
12. Partnership of Canfor Corp. and Oji Paper Co. Ltd.
13. New 240,000-tpy unit replaces two older machines.
14. May also be partially or fully groundwood specialties.
15. Based on kenaf fiber.
Source: *Pulp & Paper Week*, Canadian Pulp & Paper Assn.

ESTIMATED ANNUAL NEWSPRINT CAPACITY OF MAJOR COMPANIES

(000 metric tons)

Company	Canada	U.S.	Total	Capacity share (%)
Abitibi-Price	1,465	572[1]	1,465	12.0%
Canadian Pacific Forest Products	1,643	205[2]	1,643	10.9
Bowater[3]	218	939	1,157	6.8
Stone-Consolidated[4]	834	279	1,113	6.6
Fletcher Challenge	1,072	—	1,072	6.3
Kruger	833	53[5]	833	5.2
Boise Cascade	268	539	807	4.8
Champion International	—	805	805	4.8
Quebec & Ontario Paper	771	—	771	4.6
Smurfit Newsprint	—	709	709	4.2
MacMillan Bloedel	590	—	590	3.5
North Pacific Paper	—	524	524	3.1
Donohue	502	—	502	3.0
Daishowa Forest Products	429	—	429	2.5
Southeast Paper Manufacturing	—	406	406	2.4
Irving Paper	334	—	334	2.0
Spruce Falls Power & Paper[6]	314	—	314	1.9
Kimberly-Clark[7]	—	310	310	1.8
Domtar	258	—	258	1.5
Garden State Paper	—	209	209	1.2
Bear Island Paper	—	203	203	1.2
Alberta Newsprint[8]	194	—	194	1.1
James Maclaren Industries	191	—	191	1.1
Stora Forest Industries	174	—	174	1.0
F.F. Soucy	160	—	160	0.9
FSC Paper	—	132	132	0.8
Howe Sound Pulp & Paper[9]	95	—	95	0.6
Atlantic Newsprint[10]	85	—	85	0.5
Inland Empire Paper	—	72	72	0.4
Newsprint South	—	209	56	0.3
James River	—	16	16	0.1

Total North American capacity (1991): 16.907 million tons*
Capacity of top five producers: 42.7%
Capacity of top ten producers: 66.3%

* Preliminary figures from American Paper Institute and Canadian Pulp & Paper Assn.

1. Includes Alabama River Newsprint Co. mill (50% owned) and Augusta Newsprint Co. mill (50% owned).
2. Includes Ponderay Newsprint Co. mill (40% owned).
3. Acquired 80% of Georgia-Pacific Corp.'s East Millinocket, Maine, mill in 1991. Also includes Calhoun Newsprint Co. (51% owned) and Bowater Mersey Paper Co. Ltd. (51% owned).
4. Includes Snowflake, Ariz., mill and former Consolidated-Bathurst Inc. mills.
5. Acquired Manistique Papers Inc. in 1991.
6. Sold to a partnership of the mill's employees and Tembec Inc. in 1991.
7. Sold Spruce Falls mill (see footnote 6).
8. Greenfield mill started up in August 1990. Owned by Stern Holdings (50%) and West Fraser Timber Co. (50%).
9. Joint venture of Oji Paper Co. (50%) and Canfor Corp. (50%). Mill started up in April 1991.
10. Owned by Altantic Packaging Products Ltd. Mill started up in December 1990.

Source: Newsprint Information Committee's "Newspaper and Newsprint Facts at a Glance."

America has begun to consider adding or expanding recycled newsprint capacity to meet the legislated boost in demand, some question if it is feasible in the long term. A deinking plant and related modifications to papermaking equipment can cost $60 million or more. Too much deinking capacity could lead to a shortage of recycled fiber. And disagreement exists over how much secondary fiber can be reclaimed, as various factors such as contamination, improper handling, and lack of consumer interest have tended to limit availability in the past.

A 1990 study by Resource Information Systems Inc., Bedford, Mass., suggested that the installation of deinking facilities may not always be a good financial investment for a mill, whether by comparison with existing virgin fiber facilities or with high-grade corporate bonds. This is particularly true with 100% recycled mills, where chemical and depreciation costs may more than offset savings in fiber and labor. However, in the case of 40% recycled paper, the study notes, deinking will pay for itself everywhere in North America except the high-cost province of Quebec. These generalizations depend on the specific mill and the region of North America, with costs generally being lower in the U.S. than in Canada and with Quebec suffering from the highest costs in Canada. The study also notes that wastepaper prices will rise between 1990 and 1995 due to higher demand, partially offsetting some of the fiber cost savings related to installation of deinking.

By the end of 1991, North American mills were expected to have the capacity to produce more than 4.5 million metric tons of newsprint containing at least some percentage of recycled fiber. That number is more than twice the level of 1989. U.S. mills represent more than two-thirds of this estimated capacity. Canadian mills find it less attractive to invest in deinking facilities, as the cost of getting old newspapers to remote mill sites may in some cases be prohibitive. Nonetheless, several Canadian mills are adding deinking capacity or agreeing to buy from market deinked pulp mills, fearing that the aggressive U.S. move into deinking will erode Canada's U.S. market share. In one or two cases, Canadian suppliers are joining together to build market mills to supply their newsprint operations with deinked pulp. CPPA projects that wastepaper requirements by North American newsprint mills will rise from 1.6 million tons in 1989 to 3.2 million tons in 1992.

A study performed by Price Waterhouse Associates for Canada's Forest Sector Advisory Council (published in October 1990) showed that the average capacity of the Canadian machines included in the study (representing 80% of overall Canadian capacity) rose by 12% between 1985 and 1989, while the average U.S. machines included (representing 74% of U.S. capacity) rose by 5% (U.S. West) and 9% (U.S. South). It should be remembered that U.S. machines on average started out larger than the average Canadian ma-

CANADIAN NEWSPRINT AND GROUNDWOOD SPECIALTIES CAPACITY CHANGES, 1983-92

(metric tons)

	Newsprint	Groundwood specialties
Capacity 1982	9,920,000	765,000
Machine closures (1983-92)		
1983 Abitibi-Price, Iroquois Falls, Ont.	130,000 (4)	—
St. Marys Paper, Sault Ste. Marie, Ont.	—	20,000 (1)
MacMillan Bloedel, Powell River, B.C.	50,000 (1)	—
Stone-Consolidated, Shawinigan, Que.	40,000 (1)	—
Stone-Consolidated, Grand'Mère, Que.	15,000 (1)	—
1985 Abitibi-Price, Iroquois Falls, Ont.	55,000 (1)	—
Maclaren, Buckingham, Que.	160,000 (2)	—
1986 Canadian Pacific, Gatineau, Que.	80,000 (1)	—
1987 Abitibi-Price, Kenogami, Que.	—	60,000 (2)
Donohue, Clermont, Que.	40,000 (1)	—
1989 Stone-Consolidated, Shawinigan, Que.	45,000 (1)	—
MacMillan Bloedel, Powell River, B.C.	65,000 (1)	—
Donohue, Clermont, Que.	45,000 (1)	—
1990 Abitibi-Price, Grand Falls, Nfld.	60,000 (1)	—
Abitibi-Price, Kenogami, Que.	—	35,000 (1)
Canadian Pacific, Gatineau, Que.	75,000 (1)	—
1991 Abitibi-Price, Thunder Bay, Ont.	155,000 (2)	—
Canadian Pacific, Thunder Bay, Ont.	170,000 (2)	—
Donohue, Clermont, Que.	45,000 (1)	—
Spruce Falls, Kapuskasing, Ont.	60,000 (1)	—
Stone-Consolidated, Grand'Mère, Que.	—	70,000 (2)
Stone-Consolidated, Trois Rivières, Que.	—	30,000 (1)
1992 Canadian Pacific, Gatineau, Que.	85,000 (1)	—
Total closures	1,375,000 (24)	215,000 (7)
Increases in capacity, 1983-92		
New machines	2,430,000 (13)	300,000 (3)
Conversions to uncoated mechanical	—	1,390,000
Capacity 1992	10,975,000	2,240,000

( ) represents number of machines involved.
Source: *Canadian Paper Analyst.*

chine and finished the period larger; also, Sweden and Finland, with much larger machines on average to begin with, increased their average sizes by 27% and 13%, respectively.

In the period 1989-91, Canada shut down nine machines with capacity of 465,000 tpy (although this number includes some rotonews and offset groundwood specialties capacity that was officially classified as standard newsprint). No machines were shut down in the U.S. in that period.

Added to these Canadian shutdowns were machine conversions. Kruger converted two of its older newsprint machines at Trois Rivières to supercalendered (SC) grades (see Uncoated Groundwood chapter). Abitibi-Price converted the small Nos. 9 and 10 machines at Alma, Que., from newsprint to directory paper.

Groundwood specialties and newsprint are so closely associated that it is hard to determine capacity accurately. Some of their end uses are similar, grade descriptions are often applicable to both, and certain paper machines can make a range of groundwood-base papers. For instance, a small number of newsprint machines were equipped in recent years with the new soft-roll calenders, allowing them to swing easily between high-quality standard newsprint and groundwood specialties. In soft newsprint markets, several producers dedicate standard newsprint machines to making machine-finish grades, which usually involves running standard newsprint through more calender nips during the manufacturing process.

Three options are possible when upgrading newsprint machines to groundwood specialties: change in basis weight, increase in brightness, or improvement in finish, according to Jaakko Pöyry International Oy. A cleaner, lower-freeness mechanical pulp is required to lower basis weight, and chemical pulp content must be increased to boost strength. A change in the bleaching process is often necessary as well.

Hydrosulfite bleaching is adequate with some fiber, but southern pine may require switching to peroxide bleaching, which results in higher capital and operating costs. With borderline-quality wood, it may be possible to sort out the better wood for groundwood specialties production and to reserve the lower-quality wood for chemical pulp or newsprint production. The groundwood machine's stock and whitewater systems may also require separation from the rest of the mill to retain brightness.

If mill officials choose to upgrade the finish by adding a supercalender, wood in the woodyard should be sorted to isolate fresher and whiter wood. Low-freeness pulp is also particularly important for SC paper, and careful screening is necessary. Most SC paper mills operate with two supercalenders, which may cause layout problems in an existing mill.

Troubled industry. In the early Price Waterhouse studies of international competitiveness (1982-83), Canada had the highest manhours and labor costs per ton of output, making it the highest-cost producer among the major exporting regions. For example, it took the average Canadian mill six manhours to produce a ton of newsprint—twice the Swedish average.

Again in 1985, Canada was marginally the highest-cost supplier to the U.S. market on a delivered-cost basis. Using U.S. dollar comparisons, it cost the average Canadian mill $387 (before depreciation) to manufacture and ship a metric ton of paper to the U.S. market, compared with $386 for a southern U.S. mill, $381 for a western U.S. mill, $359 for a Finnish mill, and $345 for a Swedish mill.

Changes in currency exchange rates enabled Canada to move up toward the middle of the pack as the 1980s progressed. In 1989, Price Waterhouse estimates, it cost Finland US$527 to produce and ship a metric ton of paper to the U.S. vs $484 for a Canadian mill. However, Swedish mills could still do the job for $480, western U.S. mills for

NORTH AMERICAN NEWSPRINT INVENTORY TRENDS

(000 metric tons)

Year	Consumption (U.S.)	Year-end stocks held by all U.S. consumers	Days of supply held at year end by U.S. consumers	Year-end stocks held by all mills and consumers in North America
1990	12,126	1,241	41	1,602
1989	12,241	1,204	38	1,581
1988	12,245	1,464	46	1,800
1987	12,303	1,412	45	1,637
1986	11,873	1,263	42	1,588
1985	11,507	1,388	46	1,732
1984	11,349	1,322	45	1,679
1983	10,529	1,175	42	1,577
1982	10,096	1,258	47	1,600
1981	10,164	1,478	56	1,710
1980	10,088	1,090	42	1,275
1979	10,199	877	34	1,055
1978	9,864	970	38	1,175
1977	9,281	1,070	43	1,358
1976	8,670	1,206	52	1,506
1975	8,325	903	44	1,016
1974	9,262	1,052	48	1,212
1973	9,741	753	32	953
1972	9,551	667	26	919
1971	8,922	885	38	1,226

Source: Canadian Pulp & Paper Assn.

$431, and southern U.S. mills for $409.

The fundamental competitiveness of the various regions did not change as much as a U.S.-dollar comparison would suggest. One example is to look at production costs in local currency terms. Between 1985 and 1989, the average cost for Canada rose by a cumulative 9%, second highest among the five regions (after the 16% of the U.S. West). By comparison, the U.S. South rose by 5%, and Sweden and Finland by 6%.

Another important measure is productivity. It took Canada 5.1 manhours to produce a ton in 1985 and 4.6 manhours in 1989. Comparative numbers were as follows: U.S. West, 2.3 and 2.2; U.S. South, 3.5 and 3.0; Finland, 3.1 and 2.6; and Sweden, 3.9 and 2.8.

The 1990 study estimates that the average annual capacity per newsprint machine in Canada rose from 93,000 metric tpy to 104,000 tpy between 1985 and 1989. U.S. machines also rose in average size: for the U.S. West, from 126,000 tpy in 1985 to 132,000 tpy in 1989 and for the U.S. South, from 134,000 tpy in 1985 to 146,000 in 1989.

However, the relative competitive position of North American companies was not enhanced by this trend, since major European competitors implemented more impressive increases in productivity. For example, the average Swedish machine went from 138,000 tpy in 1985 to 175,000 tpy in 1989, and Finland went from 157,000 tpy in 1985 to 178,000 tpy in 1989.

New world-scale newsprint machines average 220,000 tpy. Canadian newsprint machines are generally older than those in the U.S. Some date back to the 1920s and 1930s, and most are at least three decades old. Despite speedups and rebuilds, these relatively inefficient machines often cannot compete with modern twin-wire paper machines.

In 1991, by one estimate, 134 machines in North America were dedicated largely or entirely to producing newsprint. Of these, 45 were in the U.S., with an average capacity of 145,000 metric tpy. The other 89 were in Canada, with an average capacity of 113,000 tpy. While this graphically suggests the difference in productivity between U.S. and Canadian mills, it also suggests that Canada has continued to make improvements in efficiency since the 1989 Price Waterhouse estimate.

ESTIMATED TOTAL MONTHLY NEWSPRINT INVENTORY HELD BY U.S. CONSUMERS

(000 metric tons/days of supply)

	1990		1989		1988		1987		1986		1985	
Month	Tons	Days	Tons	Days	Tons	Days	Tons	Days	Tons	Days	Tons	Days
Jan.	1,255	38	1,483	44	1,431	43	1,324	41	1,413	45	1,429	46
Feb.	1,279	37	1,452	42	1,474	43	1,360	40	1,435	44	1,489	46
Mar.	1,257	36	1,431	41	1,512	44	1,367	40	1,405	42	1,541	48
Apr.	1,274	37	1,328	40	1,519	45	1,360	40	1,409	42	1,527	47
May	1,301	39	1,292	40	1,507	46	1,323	40	1,371	42	1,482	48
June	1,316	42	1,307	42	1,544	49	1,405	44	1,360	45	1,475	50
July	1,380	42	1,317	40	1,599	47	1,472	43	1,410	43	1,521	49
Aug.	1,381	41	1,332	38	1,615	46	1,457	41	1,438	43	1,563	48
Sept.	1,326	39	1,319	37	1,626	44	1,509	41	1,451	41	1,527	45
Oct.	1,269	37	1,262	34	1,517	43	1,442	39	1,392	40	1,506	44
Nov.	1,233	38	1,197	36	1,446	44	1,358	41	1,161	39	1,448	46
Dec.	1,241	41	1,180	38	1,469	46	1,411	45	1,269	42	1,394	46

	1984		1983		1982		1981		1980		1979	
Month	Tons	Days	Tons	Days	Tons	Days	Tons	Days	Tons	Days	Tons	Days
Jan.	1,257	42	1,254	45	1,559	56	1,166	43	947	34	1,002	36
Feb.	1,258	41	1,272	45	1,634	58	1,234	44	1,036	36	1,029	36
Mar.	1,221	38	1,247	42	1,666	59	1,286	45	1,058	38	1,027	35
Apr.	1,194	37	1,230	42	1,629	59	1,311	46	1,097	40	950	33
May	1,263	42	1,177	42	1,598	62	1,312	49	1,147	43	907	34
June	1,430	48	1,258	47	1,565	62	1,395	54	1,195	47	938	37
July	1,497	48	1,262	45	1,530	57	1,462	54	1,208	45	991	37
Aug.	1,508	47	1,311	43	1,497	52	1,455	51	1,213	43	1,024	35
Sept.	1,478	44	1,293	41	1,423	48	1,460	49	1,212	40	938	31
Oct.	1,453	42	1,234	38	1,360	46	1,481	50	1,180	39	911	30
Nov.	1,389	45	1,219	41	1,328	47	1,480	54	1,092	39	881	31
Dec.	1,335	45	1,179	42	1,258	47	1,447	56	1,090	42	877	34

Source: Canadian Pulp & Paper Assn.

U.S. mills continue to have the advantage in terms of fiber and transportation costs. However, finance costs at U.S. mills are higher due to the relatively large number of new facilities in the U.S.

The foreign exchange rate for Canadian currency is crucial in determining the competitiveness and profitability of the country's newsprint industry. For example, a 3% to 4% rise in the Canadian-U.S. dollar exchange rate in 1988 caused Canadian mills to lose nearly 40% of a $40/metric-ton price increase implemented at the beginning of the year. The same thing happened with a price hike implemented in June 1990. The Canadian dollar rose from US85.96¢ on June 29 to as high as US88.58¢ by late August before dropping back to about US87.43¢ by July 1991. This is in contrast to the situation a few years earlier: in 1985, the Canadian dollar was worth less than US75¢.

Canadian newsprint producers have gradually lost global market share, dropping from 35.0% to 28.7% during the 1978-89 period. In addition, Canada's share loss in its biggest market—the U.S.—is expected to worsen in the early 1990s as the U.S. industry's capacity grows. However, the loss may be somewhat offset by the numerous upgrades planned for Canadian mills through 1991 and beyond, which will give Canadian producers a cost advantage more akin to U.S. producers.

Labor relations are another problem for the Canadian industry. Province-wide strikes in British Columbia and sporadic work stoppages in eastern Canada have made publishers wary of Canadian producers' long-term reliability. The Canadian Paperworkers Union (CPU) represents most unionized workers throughout the country and traditionally bargains province-wide, as in British Columbia. Otherwise, it selects a target company with which to negotiate and then applies a master agreement to subsequent negotiations, as in eastern Canada.

Until 1990, it appeared as though Canadian labor relations were improving. The latest evidence of this was during the previous round of talks, when strikes were averted entirely. In 1986, British Columbian mills bargained an agreement quickly and without incident. In 1987, eastern Canadian mills managed to sign a new contract only a few weeks after the expiration of the old agreement and without any work stoppages.

In 1990, however, eastern Canadian contracts came up for renewal once again, and workers were determined to gain in wages and other terms. CPU locals idled a number of mills for several weeks, including Rothesay Paper Ltd., Quebec & Ontario Paper Co., Abitibi-Price, and Canadian Pacific Forest Products. At one point, 11 mills were shut down, idling 23% of Canadian capacity. In 1991, contracts come up for renewal again in British Columbia, and some strike activity is considered to be very possible due to anticipated tough bargaining by both sides.

Newsprint demand. U.S. newsprint consumption totaled 12.126 million metric tons in 1990—a slight drop from 1989, which was marginally below the year before

WORLD CAPACITY FOR NEWSPRINT

(000 metric tons)

Year	Canada	U.S.	Scandinavia	Western Europe[1] (except Scandinavia)	Japan	Others	Total
1991p	10,430	6,485	4,900	4,500	3,780	7,311	37,406
1990r	10,100	6,195	4,910	4,320	3,625	6,951	36,101
1989r	10,020	5,710	4,900	3,650	3,410	6,986	34,676
1988r	9,945	5,550	4,670	3,445	3,260	6,861	33,731
1987r	9,855	5,450	4,550	3,180	2,865	6,610	32,510
1986r	9,800	5,315	4,515	3,115	2,840	6,398	31,983
1985	9,725	5,300	4,525	2,915	2,780	6,006	31,251
1984	9,710	5,305	4,630	2,720	2,720	6,174	31,259
1983	9,885	5,235	4,685	2,475	2,730	5,797	30,807
1982	9,920	5,130	4,380	2,455	2,710	6,651	30,816
1981	9,490	4,950	4,045	2,405	2,885	5,066	28,841
1980	9,130	4,420	3,930	2,470	2,770	4,951	27,671
1979	9,065	3,810	3,860	2,405	2,710	4,586	26,436
1978	8,980	3,710	3,640	2,375	2,640	4,346	25,691
1977	8,985	3,690	3,430	2,250	2,480	4,205	25,040
1976	9,000	3,641	3,283	2,190	2,350	3,921	24,385
1975	8,974	3,582	3,088	2,506	2,296	3,526	23,972

p = Preliminary.
r = Revised.

[1] East Germany included in Western Europe from 1990 on. Estimated East German capacity for 1990 and 1991 is 165,000 metric tons.

Source: Canadian Pulp & Paper Assn., Newsprint Data; *Pulp & Paper.*

that. With consumption sharply down in first-half 1991, it appeared that a highly unusual four-year downtrend was in place. Some observers feared this trend reflected a permanent degeneration of newsprint markets, although in some respects the recent period resembled the stagnation of the early 1970s—which was brought on by dislocations in the macroeconomic environment.

Regions of the U.S. that saw growing demand in 1990 were primarily those along the Pacific and Gulf Coasts and in the southeastern U.S., while the Northeast and the Midwest saw modest declines (up to 4.9% in the case of the region encompassed by New York, New Jersey, and Pennsylvania). The largest region in the country in terms of demand is the South (extending as far west as Texas); U.S. and Canadian mills shipped 3.9 million tons to that region in 1990. Following the South is the West, with 2.9 million tons; then comes the Northeast, with 2.7 million tons; and the Midwest, with 2.5 million tons.

Newspaper industry trends. Newsprint demand is usually determined by the performance of the daily newspaper industry because it is by far the chief consumer of newsprint, accounting for nearly 75% of total U.S. consumption in 1990. That percentage has dropped slightly over the years: in 1980 it was over 77%. The balance of shipments goes primarily to weekly newspapers and other commercial printing applications (newspaper inserts being the largest).

Advertising and circulation figures are watched closely to determine how much newsprint will be consumed in a given year. It was no surprise that when daily newspaper advertising expenditures grew at only 80% of the rate of the GNP (both in current dollars) between 1985 and 1990, newsprint consumption growth (tonnage) fell behind real GNP growth, rising at just 32% of the GNP growth rate. Advertising in the late 1980s was the first expenditure cut by many cost-conscious retailers. And because of the economics of newspaper publishing, every page of advertising that is cut tends to eliminate a page of news at the same time.

Another major headache for newspapers in the 1990-91 period has been the weakness in classified advertising. Classified (primarily help-wanted, real estate, and auto sales) ads have always been more profitable than display ads since they do not enjoy volume discounts. In some daily newspapers, a majority of advertising revenue comes from classifieds. Thus, when economic conditions undermine the sources of classified advertising, newspapers have to make significant cuts elsewhere in their operations. And, according to *Editor & Publisher*, a study by newspaper consultants Veronis, Suhler & Associates Inc. estimates that classified ad expenditures grew at a double-digit rate as recently as 1986. Veronis, Suhler said the growth rate in 1989 was still positive: 2.8%. But then in 1990, classified ad revenues dropped by 3.3% and were forecast to slide by another 5% in 1991 before rising by 4.1% in 1992, 8% in 1993, and 13.5% in 1994.

WORLD DEMAND FOR NEWSPRINT

(000 metric tons)

Year[1]	North America	Western[2] Europe	Asia, Africa, Oceania	Eastern[2] Europe	Latin America	Total*
1990p	13,238	8,195	7,614	2,038	1,540	32,626
1989r	13,123	7,465	7,218	2,200	1,529	31,535
1988r	13,495	7,158	6,898	2,098	1,544	31,189
1987r	13,609	6,691	6,319	2,033	1,552	30,203
1986r	12,845	6,291	6,147	1,929	1,506	28,718
1985	12,589	6,032	6,117	1,896	1,275	27,905
1984	12,555	6,023	6,847	1,825	1,184	28,434
1983	11,409	5,574	5,566	1,761	1,760	26,070
1982	10,811	5,424	5,333	1,669	1,184	24,421
1981	11,593	5,570	5,651	1,707	1,538	26,059
1980	11,280	5,640	5,318	1,647	1,326	25,211
1979	11,075	5,355	5,166	1,694	1,192	24,482
1978	10,700	5,079	4,872	1,683	1,088	23,422
1977	9,966	4,796	4,624	1,716	1,169	22,271
1976	9,821	5,092	4,311	1,694	962	21,880
1975	9,029	4,975	4,064	1,670	924	20,662
1974	10,437	5,622	3,672	1,613	1,358	22,702
1973	10,661	5,497	3,446	1,532	1,264	22,400
1972	10,059	5,100	3,388	1,509	1,295	21,351
1971	9,517	4,979	3,263	1,467	1,285	20,511
1970	9,533	5,269	3,173	1,418	1,449	20,842
1969	9,688	5,113	2,958	1,337	1,297	20,393
1968	9,080	4,553	2,595	1,264	1,184	18,676
1967	8,887	4,222	2,355	1,200	1,084	17,748
1966	8,998	4,419	2,077	1,095	985	17,574

*Totals may not add up exactly due to rounding off of some figures.

1. Figures prior to 1974 do not include People's Rep. China.

2. From 1990 on, East Germany included in Western Europe. East Germany estimated in 1990 at 198,000 metric tons.

Source: Canadian Pulp & Paper Assn., Newsprint Data.

The most publicized—and significant—problem for the U.S. newspaper industry is the erosion of its audience. Daily newspaper circulation has been flat since 1970; in that year it grew to 62.1 million, and in 1990 was estimated at 62.3 million. In contrast to daily sales, Sunday circulation has steadily gained ground. It reached just 49.2 million in

1970 but had climbed to 62.4 million by 1990.

Perhaps more significant from the advertiser's point of view—and hence from the publisher's—is the percentage of the adult population reading newspapers. In 1970, according to the Newspaper Advertising Bureau, 78% of all adults read a weekday newspaper. In 1990, the percentage was just 62.4%. The share of Sunday readership actually declined over that period too, from 72% to 67%. But the Sunday share has stayed between 64% and 68% since 1973, which may explain why the number of newspapers publishing a Sunday edition has grown (from 586 in 1970 to 865 in 1990) while the number of companies publishing a weekday newspaper has dropped (from 1,748 in 1970 to 1,611 in 1990).

Modest circulation growth combined with advertising lineage (volume) gains have kept newsprint consumption

NEWSPRINT PRICES, 30-LB DELIVERED

(US$/metric ton)

	Eastern			West Coast		
Year	List	Transaction	Effective	List	Transaction	Effective
1991						
2Q	$685	$552		$630	$560	
1Q	685	570		630	575	
1990						
4Q	685	565		630	570	
3Q	685	565		630	575	
2Q	650/685	535/565	6/1-7/1	630[1]	540/575	6/1
1Q	650	535		630	540	
1989						
4Q	650	535/540		630	540/545	
3Q	650	550/575		630	550/560	
2Q	650	575		630	560	
1Q	650	585/612		630	580	
1988						
4Q	650	600		630	590	
3Q	650	610		630	598.50	
2Q	650	610		630	598.50	
1Q	650	610	1/1-3/1	630[2]	598.50	1/1-2/1
Year end						
1987	610	570	7/1-9/1	600[3]	552.90	7/1
1986	570	500/550	10/1-12/30	570	514.50	10/1
1985	535	505		535[4]	508.25	
1984	535	510	7/1	500/535	508.25	3/1, 10/1
1983	500	475	9/1	468.50[5]	445	
1982	468.50	445/468.50	11/1	468.50	445	8/1
1981	470/500	490	1/1, 8/1	470/500	470	1/1, 8/1
1980	440	440/470	5/1	440	440	5/1
1979	380/413	380/413	1/1-2/1, 10/1-11/1	380/413	380/413	1/1-2/1, 10/1-12/1
1978	353	353	2/1-4/1	353	353	4/1
1977	336	336		331	331	
1976	314/336	314	3/1, 11/1-12/1	331	331	7/1
1975	287	284	1/1	309	309	1/1
1974	259	259	7/1	270	270	8/1
1973	199/206/235*	220	2/1, 6/1, 11/1	197/235	197/235	1/1, 9/1-12/1
1972	194*	182	2/1	192	192	1/1
1971	188*	176	4/1	182	182	1/1
1970	179*	168	1/1	173	173	1/1

*Prices are for paper made by Canadian mills; prices in these years for southern-manufactured paper are generally about $2 lower. Effective dates for Canadian and southern mills are generally the same, except for 1972, when the southern price took effect a month later on 3/1.

1. Discount of 5% dropped effective 6/1/90, eliminating all general discounts.
2. Discount of 3% dropped effective 1/1/88, leaving a 5% discount.
3. One previously implemented 5% discount reduced to 3%, effective 7/1/87.
4. A second 5% discount added by West Coast producers, effective 10/1/85.
5. West Coast producers announced 5% discount from list, effective 7/1/83.

Sources: American Newspaper Publishers Assn., *Pulp & Paper Week*.

growing during most of the 1980s. Overall, U.S. newsprint consumption rose at an average rate of 2.8%/year between 1980 and 1986. In 1987, the gain in newsprint consumption measured 3.0%. But since then, advertisers, who were already concerned about slow circulation growth, have responded to economic hard times by reducing their newspaper ad budgets more sharply than their budgets for television or radio.

North American newsprint producers had grown accustomed to a demand growth rate that outstripped the GNP. But that pattern had not always been the rule. Between 1970 and 1975, newsprint consumption rose by just 1.5%, compared with an 11.5% increase in real GNP. Then for the next ten years, newsprint did outstrip economic activity, rising 20.7% in the second half of the 1970s (vs 18.3% in real GNP) and 14.2% in the first half of the 1980s (vs 13.5% in GNP). But the second half of the 1980s brought a return to the weak advertising markets of the early 1970s, with newsprint consumption rising just 4.8% between 1985 and 1990 while GNP increased 14.9%.

EXPORT PRICES FOR NEWSPRINT IN SELECTED MARKETS

(per metric ton)

	Canada to U.K.[1]		Finland to U.K.[2]	
	C$	US$	£	US$
1991				
3Q	C$662.19[3]	US$577.32	£450	US$758.57
2Q	696.33	609.75	450	729.68
1Q	758.56	654.66	450	780.98
1990				
4Q	666.44	574.37	450	867.60
3Q	698.40	603.89	450*	843.08
2Q	628.10	538.63	425*	740.27
1Q	661.12	564.96	425*	698.19
1989				
4Q	594.60	513.56	425*	682.34
3Q	623.03	528.75	425*	690.71
2Q	661.76	552.25	425*	658.84
1Q	723.42	606.29	425	717.74
1988				
4Q	733.07	614.63	425	769.04
3Q	753.80	619.34	425	716.34
2Q	763.23	629.36	400/425	705.09
1Q	698.56	566.05	400/425	775.42
1987				
4Q	670.06	515.51	400*	748.60
3Q	657.92	502.57	400*	651.88
2Q	677.75	509.13	400*	644.00
1Q	656.03	502.67	365*	585.83
Year end[4]				
1986	621.50	450.20	365*	538.19
1985	622.79	445.65	345	498.35
1984	489.17	370.19	321	371.24
1983	527.75	424.10	300	435.18
1982	606.44	493.28	300	484.35
1981	615.37	518.91	300	572.40
1980	631.44	528.53	270	643.95

*Discounting from list prices reported.

1. F.o.b. point of lading, 30-lb.
2. Delivered to U.K. pressroom, 48.8-g/m².
3. For July and August only.
4. Fourth-quarter figures for applicable years.

Sources: Statistics Canada, *Pulp & Paper International*.

Part of the problem with U.S. newsprint demand in the late 1980s is attributable to upheaval in the retail industry. Leveraged buyouts of R.H. Macy's, Federated Department Stores, and Allied Stores led to a cutback in national advertising. One publisher in a major metro market says that of his ten largest advertisers in 1980, only three remained in early 1991 as separate entities—and all three were said to be for sale.

Financial advertising was hurt by the stock market's plunge in late 1987, and newspapers had to deal with a 25% boost in postal rates in April 1988. And competitive advertising from magazines, television, and newer types of promotional media, such as store displays and shopping carts, also had an impact. Furthermore, advertising in all media has been growing more slowly since merchandisers in the 1980s began shifting their dollars to trade and consumer discounts (promotions) as opposed to traditional advertising.

Contributing to stagnation in advertising were the sluggish economy, with little improvement in consumer spending, and declines in the automobile and real estate markets. Although newspapers remain the leader in terms of advertising revenues, their share of total media advertising revenue has steadily contracted, from 27.6% in 1980 to 25.3% in 1990.

Preprinted inserts currently account for about one-third of all newspaper ad volume but represent only about one-tenth of a newspaper's ad revenues, according to NAB. Over half of what advertisers spend on preprints goes to printers, and only 45% goes to newspapers.

Daily newspapers face a serious challenge in the 1990s: to show advertisers that they can hold on to—and even increase—their audience. One 1991 survey asked media buyers to rank the media according to the growth they expected in the next five years; while the broadcast and cable media led the list, daily newspapers finished dead last.

Many observers think that the relative success of lifestyle-oriented and niche media in the 1980s—ranging from cable TV to the Sunday newspaper—means that the daily newspaper of the future will have to look a lot more like the Sunday paper, with a proliferation of stories and special sections targeted at specific audiences and a variety of substrates to support a more graphically attractive style. Ironically, just as the newsprint industry is focusing on learning to produce a commodity more cost-effectively, its major customers may be starting to look for suppliers who can meet increasingly varied printing needs.

Newsprint prices. Pricing collapsed in the late 1980s. Experienced salespeople said in 1991 that they had never seen a pricing environment as chaotic as the current situation. Real prices were actually lower in 1991 than in 1970—an enormous problem for new capacity built in the 1980s on the basis of often optimistic pricing assumptions as well as for older capacity burdened with high operating costs.

By mid-1989, discounts of 20% and higher were quoted on contract shipments. This climate was truly amazing, considering that mills were operating near capacity levels for much of the time. The market appeared to be in the grips of what some observers called "psychological factors," with both buyers and sellers acting in anticipation of the capacity expansion cycle of 1989-91. Preselling of tonnage from new machines coming onstream was widespread, which forced existing producers to meet competitive discounts or risk losing volume.

This puzzling phenomenon was followed by another year of surprises in 1990. With profits in a tailspin (especially for Canadian mills), North American newsprint manufacturers resisted all signs pointing thumbs down to a price hike—with the single exception of an uncertain labor climate—and pushed one through on June 1, 1990. This boosted list levels to US$685/metric ton in the U.S. East and to $630/metric ton in the U.S. West. Then, three months later, producers began to announce plans for another price increase for Jan. 1, 1991, to $720/metric ton in the East and $665/metric ton in the West. However, this increase failed and was withdrawn in February and March of 1991, a casualty of very high customer inventories (equal to 46 days of supply at the end of March 1991, compared with 39 days at the end of May 1990, when the previous increase took effect). After that failure—with North American mill inventories nearing record levels and operating rates falling, it appeared that a price increase in 1991 was unlikely.

In fact, following the collapse of the January 1991 increase, aggressive selling pushed discounts up to 22% to 25% and higher in the case of large contract customers and to 28% to 30% for spot business. Some time in 1991, the average discount east of the Rockies passed 20%, at which point the typical Canadian producer was estimated to be losing money on a cash flow basis. Even the lower-cost U.S. industry was probably making less than $50/metric ton at that price—and prices were still heading down.

Newsprint in the eighties. Newsprint is a cyclical business. Capacity surges following periods of tight supply are well known to seasoned industry observers. One such surge began in late 1979 and ended in early 1983. The next four years were virtually flat. But between late 1987 and early 1988, newsprint profits soared, and companies began spending their available cash on new capacity, producing a new capacity surge running from late 1989 through 1991.

Anticipation of excess capacity eroded prices as early as March 1988—a year before startup of the first new newsprint machine. This down cycle should last through 1992, with possible episodes of firming caused by labor strife, machine shutdowns, or other unforeseen circumstances.

Prior to the 1980s, North American newsprint prices were dominated by the actions of a few Canadian producers, generally referred to by U.S. publishers as "the club." Then a combination of rapid capacity expansion in North America in the early 1980s and unusually strong North American currencies produced a surplus of U.S. and Canadian tonnage available for sale in the U.S. In addition, an influx of paper from previously less-important sources, such as Scandinavia, continental Europe, Latin America, and South Africa, helped lead to the demise of the club.

From 1981 until 1986, prices vacillated but remained es-

U.S. NEWSPRINT CONSUMPTION, DAILIES vs OTHER USES

(000 metric tons)

Year	ANPA "525"	Other dailies	Other uses	Total consumption
1990	7,479	1,494	3,153	12,126
1989	7,546	1,549r	3,146r	12,241
1988	7,548	1,502	3,195	12,245
1987	7,606	1,519	3,178	12,303
1986	7,422	1,443	3,008	11,873
1985	7,199	1,525	2,783	11,507
1984	7,075	1,457	2,899	11,349
1983	6,638	1,260	2,700	10,529
1982	6,358	1,249	2,501	10,096
1981	6,506	1,307	2,351	10,164
1980	6,581	1,208	2,299	10,088
1979	6,673	1,208	2,318	10,199
1978	6,446	1,174	2,257	9,877
1977	6,143	1,084	2,052	9,279
1976	5,928	1,020	1,771	8,719
% change 1976-90	26.2%	46.5%	78.0%	39.1%

r = Revised.
Source: American Newspaper Publishers Assn.

LARGEST U.S. DAILIES AND 1990 NEWSPRINT USAGE

Newspaper	Circulation[1]	Newsprint consumption[2] (metric tons)
Wall Street Journal	1,919,355	147,857
USA Today	1,503,496	148,000
Los Angeles Times	1,242,864	473,206
New York Times	1,209,225	309,000
Washington Post	838,902	226,799
Newsday	625,902	143,372
Chicago Tribune	741,345	209,646
New York Post	644,738	44,264
Detroit Free Press	622,349	n.a.[3]
San Francisco Chronicle	570,364	118,643

n.a. = Not available.
1. From Audit Bureau of Circulation figures as of Mar. 31, 1991.
2. Independent verification.
3. Joint operating agreement with Detroit News; records not kept separately.
Source: "Newspaper and Newsprint Facts at a Glance," from Newsprint Information Committee.

sentially flat due to deep discounting. List price increases were attempted at the same time that publishers were offered deeper cuts from the new, increased lists.

During that period, global overcapacity, combined with erratic U.S. economic growth and strong U.S. and Canadian currencies, hurt North American newsprint exports and drew imports from Scandinavia. The period began with an official list-price reduction from $500 to $468.50/metric ton in October 1982. The list was then raised to $535/metric ton in third-quarter 1984, but this level was increasingly eroded by discounting until the end of 1986.

Such pricing caused Canadian newsprint profits to decline sharply. Jim Rowland of *Canadian Paper Analyst* estimated that pre-interest, pretax profit of Canadian producers on shipments to the U.S. declined from a high of about C$125/metric ton in 1980-81 to a low of $50 in 1983. It recovered to about $100 in 1986.

Producers pushed through a $35/metric-ton price increase in late 1986 for a new list of US$570 in the eastern U.S. Other price increases in July 1987 and January 1988 pushed prices up to $650 in the East and $630 in the West (less a 5% standard discount in the West). Actual price increases were even larger as producers tightened up on discounts that had driven down transaction prices in 1986 to around $470 to $480/metric ton.

The success of the late-1986 price hike seemed to mark the dawning of a new cycle for the newsprint industry, one in which the producers would call the shots. Because of limited newsprint capacity expansions through the end of the decade, mills were expected to continue raising prices through 1988. However, since it was widely expected that the next round of capacity expansion would lead to a renewal of weak pricing, some producers tried to insulate themselves in advance from this anticipated discounting by offering customers higher discounts in return for promises of continued high purchases. These policies became self-fulfilling prophecies, and price hikes failed in late 1988 and early 1989 and were abandoned. As a result, the industry lost control of its own pricing and rarely regained it in the following two years.

As the 1980s drew to a close, the newsprint industry was faced with a group of major customers who were more professional than ever before and who, facing the deep-seated problems of the newspaper industry, were fully motivated to resist their suppliers' attempts at improved profitability. These customers wielded unprecedented power due to the large volume of their purchases and were armed with the knowledge that the mills would have to shut down an enormous amount of capacity before pricing control could be regained by the suppliers.

About the only consolation enjoyed by the producers going into the early 1990s was the knowledge that, sooner or later, the investment required by the drive toward recycling would displace investment that would normally go into new capacity. This, in turn, might defer the next round of capacity increases and allow the industry to return, at least briefly, to profitability.

OUTLOOK

The outlook for newsprint in the early 1990s is troubled. Demand slowed in mid-1988 and flattened through 1989 and much of 1990. In August it headed down and by March 1991 was falling at a 10% rate (from year-earlier months). At the same time, about 2.5 million metric tons of new North American newsprint capacity began coming onstream, with 12 machines expected to start up during 1989-91. Netted of announced or likely shutdowns, this translates into an increase in the 1989-92 period of 1.6 million tons of capacity—at a time when North American demand is projected to drop by 535,000 metric tons (from 13.495 million metric tons in 1980 to 12.960 million metric tons in 1992). Since net North American exports are projected to grow by only 330,000 tons in that period, it seems unlikely 1992 will be the occasion of a major market upturn.

In spring 1991, consumers set about to reduce their inventories (which climbed 196,000 tons between Dec. 31, 1990, and the end of February 1991). However, during that

MEDIA SHARE OF U.S. ADVERTISING REVENUES

	1990		1989		1980		1970	
	million $	%	million $	%	million $	%	million $	%
Daily newspapers	$32,281	25.1%	$32,368	26.1%	$14,794	27.6%	$5,745	29.3%
Magazines	6,803	5.3	6,716	5.4	3,149	5.9	1,323	6.8
Television	28,405	22.1	26,891	21.7	11,474	21.4	3,665	18.7
Radio	8,726	6.8	8,323	6.8	3,702	6.9	1,278	6.5
Direct mail	23,370	18.2	21,945	17.7	7,596	14.2	2,734	13.9
Business publications	2,875	2.2	2,763	2.2	1,674	3.1	740	3.8
Outdoor	1,084	0.8	1,111	0.9	578	1.1	234	1.2
Others*	25,096	19.5	23,601	19.2	10,583	19.8	3,881	19.8
Total	128,640		123,930		53,550		19,600	

*Others include farm publications, *Yellow Pages*, and miscellaneous.
Sources: McCann-Erickson Inc., Newspaper Advertising Bureau Inc.

same period, U.S. consumption started to slide badly, dropping from an annual rate of 11.83 million metric tons in December to 11.5 million in February and 11.22 million in March. Thus, in terms of days of supply, consumer stocks were actually higher going into the second quarter (46 days at the end of March and again at the end of April) than going into the first period (41 days at the end of December 1990 and 45 days at the end of January 1991). (By the end of May, with consumption still plummeting, consumer inventories were at 48 days.) In this situation it was not difficult for publishers to use this excess supply as a weapon against the Jan. 1 price increase—with devastating effect as far as the mills' bottom lines were concerned. By mid-1991, the average Canadian mill was losing money (on an operating basis), and pricing was still drifting lower going into the summer.

Forecasters expected 1991 North American operating rates to dip down to the high 80s to low 90s, as the seven new newsprint machines that came onstream in 1989 and 1990 built up speed and were joined by another five machines coming onstream in 1991. U.S. mills were faring better than Canadians on operating rates, as more Canadian capacity was idled by the devastating profit picture. In fact, it was no surprise to most observers when Spruce Falls Power & Paper Co.'s owners announced at the end of June 1991 that their attempt to sell their unprofitable mill to em-

NORTH AMERICAN DEINKED NEWSPRINT PROJECTS, 1990-94

Company/mill site	Startup	Deinking capacity[1] (metric tpy)	Recycled fiber content (%)	Recycled requirements (metric tpy)	grades
Definite					
Abitibi Price, Thunder Bay, Ont.	May 1992	55,000	40%	76,550	ONP, OMG
Alabama River Newsprint, Claiborne, Ala.	Spring 1992	100,000[3]	45	140,000	ONP, OMG
Atlantic Packaging, Whitby, Ont.	Jan. 1991	135,000[2]	100	180,000	ONP, OMG
Augusta Newsprint, Augusta, Ga.	Sept. 1990	90,000[3]	Var.	115,000	ONP, OMG
Bear Island, Ashland, Va.	Late 1992[3]	43,500	20	60,000	ONP, OMG
Boise Cascade, West Tacoma, Wash.	1992	70,000[3]	40	110,000	ONP, OMG
Bowater, Calhoun, Tenn.	Sept. 1991	109,500[3]	Var.	138,700	ONP, OMG
Canadian Pacific, Thunder Bay, Ont.	Late 1991	100,000[3]	Var.	116,000	ONP, OMG
Gatineau, Que.	Late 1991	182,500[3]	Var.	211,000	ONP, OMG
Cascades/Donohue, Maclaren, Cap de la Madeleine, Que.	Early 1992	90,000	20	112,900	ONP, OMG
Champion International, Sheldon, Texas	Late 1992	138,800[3]	20	208,000	ONP, OMG
Daishowa Forest, Quebec City, Que.	Feb. 1992	110,000[3]	n.a.	120,000	ONP, OMG
Port Angeles, Wash.	Spring 1992	65000[6]	Var.	75,000	ONP, OMG, old directories
Inland Empire, Millwood, Wash.	Late 1991	37,000[3]	40	42,000	ONP
Kruger, Bromptonville, Que.	1992	41,640[5]	Var.	52,050	ONP, OMG
Newstech Recycling, Vancouver, B.C.	4Q 1991	122,500[4]	Var.	140,000	ONP, OMG
North Pacific Paper, Longview, Wash.	Apr. 1991	156,150[2]	Var.	225,550	ONP
Smurfit Newsprint, New York State	1994+	n.a.	n.a.	n.a.	ONP, OMG
Stone-Consolidated, Shawinigan, Que.	Early 1993	70,000[3]	Var.	83,000	ONP, OMG
Indefinite					
Alberta Newsprint, Whitecourt, Alta.	n.a.	n.a.	n.a.	n.a.	n.a.
Evergreen Paper, Red Rock, Ariz.	1Q 1994	230,000	100	n.a.	ONP, OMG
Fletcher Challenge Canada, Elk Falls, B.C.	n.a.	n.a.	n.a.	n.a.	n.a.
Crofton, B.C.	n.a.	n.a.	n.a.	n.a.	n.a.
Georgia-Pacific, East Millinocket, Maine	Late 1992	86,750	Var.	120,000	ONP, OMG
Kenaf Paper, Raymondville, Texas	n.a.	n.a.	n.a.	n.a.	n.a.
Manistique Papers, Manistique, Mich.	n.a.	34,700[6]	100	n.a.	Mixed
Ponderosa Fibres, New York, N.Y.	Spring 1993	105,000	n.a.	n.a.	n.a.

ONP = Old newspapers. OMG = Old magazines. Var. = Variable.

1. Adding deinking capacity does not necessarily mean an increase in papermaking capacity.
2. New paper machines at greenfield or existing mills.
3. New deinking facilities to be added to existing mills.
4. Greenfield market deinked pulp mills.
5. An additional 100,000 will come online by 1995.
6. Also produces groundwood specialties grades.

Sources: Canadian Pulp & Paper Assn., *Pulp & Paper Week*.

ployees had failed and that they were going to have to shut down three of the facility's four machines—at a loss of 240,000 metric tons in capacity and 1,200 jobs. This was widely seen more as a symbol of the Canadian industry's overall state than as an exception.

Certainly not all Canadian producers were in equally bad shape. Operations like Donohue, Gold River Newsprint Ltd., Finlay Forest Industries Ltd., and Kruger are modern, world-class mills. And companies like Canadian Pacific Forest Products and Abitibi-Price were moving aggressively in 1991 to eliminate unprofitable machines and mills and to reduce overstaffing. But in a market environment complicated by increased customer demands for recycled paper, downward pressures on pricing, and a relatively strong Canadian dollar, the U.S. industry was in a much better position to weather the storm than its northern counterpart.

Parts of the U.S. industry were in a weak position too. Georgia-Pacific's Maine mills were in need of modernization, and the company was very slow to move to a decision on installation of a deinking plant. New machines or mills like Alabama River Newsprint Co., Newsprint South, North Pacific Paper Corp., Ponderay Newsprint Corp., and Southeast (all started up since the beginning of 1989) undoubtedly felt financial pressures (in a weak pricing environment) from their capital costs. But those were all new, modern, very efficient mills able to produce top-quality newsprint and located close to their major markets. And most other U.S. producers were relatively more efficient than their average Canadian competitors, with larger machines, lower labor costs, and smaller freight bills. The U.S. industry's share of its domestic market rose from 40% at the beginning of the 1980s to 48% in the early 1990s, and all of that gain came at the expense of Canada.

Clearly the Canadian industry that survives the current downturn will be fully competitive in the U.S. and other markets. But most observers feel it would be late 1992 or even late 1993 before the industry gets a breathing space from recent hard times.

A long-term forecast done for ANPA in 1990 by Jon G. Udell projected a "fairly severe recession" for 1990-91 and economic growth averaging 2%/year between 1989 and 1995, resulting in U.S. consumption in 1995 of 13.5 million tons. If the Udell scenario holds true (and Dr. Udell's projections in past years have been among the most accurate), it would represent growth over 1989 of 1.26 million tons—while capacity growth between 1989 and 1993 is currently projected by many observers at closer to 1.6 million tons. Clearly, without further rationalization in the industry, it is going to be a struggle for the industry to return to high profits in the early 1990s. And some observers doubt that consumption will grow at all in the next two to three years, far from increasing by more than a million tons.

Other factors may tend to limit growth in U.S. consumption. Some publishers have concluded that a large circulation base is too expensive to maintain, since advertisers seem increasingly less inclined to support it and the cost of distributing newspapers continues to climb. Rather than placing increased circulation at the top of their list, they have begun raising newsstand and subscription prices—even at the risk of losing readers. Many publishers have also continued to raise advertising costs even in the face of declining demand; newspaper ad rates rose 6.8% on average in 1991, while ad pages were declining. Thus, the cost-effectiveness of newspaper advertising may be seen by advertisers to be dropping. This issue of cost-effectiveness is one the publishing industry will spend the first half of the 1990s addressing.

Surprisingly, in view of economizing measures taken by many publishers in the early 1980s, newspapers continued in 1991 to find ways to reduce newsprint without reducing printed pages. For example, average trims were dropping from 55 in. to 54 in. or below in some cases. Some publishers were also quick to shut down sections or issues that did not pay for themselves, rather than staying with them to see if more time produced success.

COMPARATIVE NEWSPRINT MANUFACTURING COSTS FOR MAJOR PRODUCING REGIONS, 1989

(US$/metric ton)

	Canada	U.S. West	U.S. South	Finland	Sweden
Furnish material	145	172	121	240	181
Energy	70	72	80	81	83
Labor	103	61	72	51	64
Other	69	71	88	56	78
Mill level cost	387	376	361	428	406
Corporate/ selling cost	27	12	17	29	9
Cost before delivery	414	388	378	457	415
Delivery	70	43	31	70	65
Total delivered cost	484	431	409	527	480

Source: Forest Sector Advisory Council of Canada, "Newsprint Cost Study" for 1985-89.

And finally, some observers think the newspaper of the future will resemble the Sunday paper of today—with a proliferation of special issues, demographic sections, various paper grades, and various trims. While this may contribute in time to increased paper demand, not all of the increase will represent newsprint. And such a newspaper will require far more servicing and product development effort on the part of the paper mill.

Overseas markets. World demand for newsprint in 1989 reached 31.5 million metric tons, according to CPPA. The Food & Agriculture Organization of the United Nations predicted that world consumption will grow to about 42 million tons in the year 2000. CPPA expected Canadian newsprint shipments to rise during this time to 12 million tons.

The largest share of total 1990 North American newsprint exports to offshore customers was from Canada. In fact, Canada shipped about three and a half times as much newsprint overseas as did the U.S. Offshore exports of U.S. newsprint, however, grew between 1980 and 1989, from 176,000 metric tons to 427,000 tons. For the same period, Canadian newsprint exports to offshore destinations were up marginally, from 1.524 million metric tons to 1.576 million tons.

Exports to western Europe from Canada declined between 1980 and 1986 but began growing again in 1987. They increased in 1988 and again in 1989, reaching a new peak of 744,000 metric tons, with over 60% of that amount sold to the U.K. Then in 1990, they dropped to 674,000 tons due entirely to a decline in shipments to the recession-plagued U.K. Exports to Asia dropped in 1990 by 5.6% to 398,000 tons. However, shipments from Canada to Latin America jumped by more than 7% to 375,000 tons. Other markets for Canadian exports showed declines.

Since 1980, Scandinavian producers have had an edge in trading with western Europe. During that time, the European Economic Commission imposed a tariff-free import quota of 650,000 metric tpy of newsprint not produced by EC countries; newsprint from Scandinavia entered western Europe tariff-free.

Exports to the U.K. from Canada dropped significantly in the mid-1980s due not only to falling newspaper circulation but also to currency exchange rates, increased imports from Scandinavia, and increased production within the U.K. This trend continued through the 1980s.

With Japanese newsprint consumption projected to rise over the next few years, North American producers have an expanded market to cultivate. They should have an advantage over other global suppliers because of Japanese ownership in several U.S. and Canadian newsprint mills.

Japan is already a leading customer for the U.S., with Jujo Paper Co. Ltd.'s 20% interest in the North Pacific Paper mill at Longview, Wash., and Daishowa America's ownership of the Port Angeles, Wash., mill. In Canada, Oji Paper Co.'s 50% partnership with Canfor Corp. in the new Howe Sound venture will have a significant effect on where that mill's output is marketed.

One new paper machine was being built in Japan in 1991: a 220,000-tpy unit at Daishowa's Iwanuma, Japan, mill. Other machines starting up in Asia include Hindustan Newsprint Ltd.'s 45,000-tpy machine at the Kumarbagh, India, mill in 1991.

Rep. Korea too is expanding. It is likely to become a bigger exporter of newsprint in 1990-92, when two new machines amounting to about 200,000 tpy of new capacity are scheduled to come online. According to one estimate, Rep. Korea could be exporting more than 100,000 tpy by 1992.

In early 1992, Venezuela was expected to bring online a new 200,000-tpy newsprint mill—that country's first. However, that project appeared to be indefinitely delayed due to the withdrawal of Abitibi-Price, one of the partners.

In western Europe, though, Norske Skog is bringing onstream a new 200,000-tpy mill in Gobley, France, in early 1992 and was to add 100,000 tpy at its Skogen mill in Norway due to machine improvements. In 1993, Papel de Edicones (Padesa) will have completed a 200,000-tpy mill in Alava or Burgos, Spain. And a new 200,000-tpy machine was announced for 1993 startup at Holmens Bruks' Braviken Mill in Sweden.

Plans to build a 220,000-tpy recycled newsprint mill in Gartcosh, Scotland, were still uncertain in mid-1991. Originally Abitibi was to be an equal partner in the project with two publishers, The Daily Telegram plc and Mirror Group Newspapers Ltd. But in 1991, Abitibi dropped out of the project citing worldwide overcapacity, and it was not clear when—or if—the project would go ahead.

HISTORICAL TREND IN TOTAL NEWSPRINT DELIVERED COST, 1982-91

(US$/metric ton)

	1991*	1990*	1989	1988	1987	1986	1985	1984	1983	1982
Canada	$550	$512	$484	$441	$397	$379	$387	$385	$407	$408
U.S. West	471	453	431	407	372	368	381	388	370	387
U.S. South	446	429	409	391	383	364	386	384	379	368
Finland	599	636	527	505	473	416	359	331	369	384
Sweden	582	591	480	492	450	403	345	306	312	322

* *Pulp & Paper Week* estimate based on exchange rates in August 1990 and June 1991 and including effect of inflation.
Source: Forest Sector Advisory Council of Canada, "Newsprint Cost Study." Data for years 1985-89 are from the 1985-89 study; data for years 1982-84 are from 1982-86, 1983-87, and 1984-88 studies.

Paper:

UNCOATED GROUNDWOOD

A number of years ago, uncoated groundwood papers were considered a slightly more prestigious version of newsprint (which they are closely related to on the low-quality end but distinct from on the high-quality end). Groundwood papers have physical properties similar to newsprint and use primarily stone groundwood pulp. However, uncoated groundwoods have better printing characteristics than newsprint, with the high-end supercalendered (SC) papers competing with coated grades. In the same vein, uncoated groundwoods are priced in between newsprint and coated groundwood grades. The small groundwood forms paper sector (estimates range from 150,000 to 250,000 short tpy) competes with uncoated free-sheet forms bond and also with blended fiber papers, which can include bleached chemi-thermomechanical pulp (BCTMP), a newer grade of pulp between stone groundwood (mechani-

STATISTICS FOR UNCOATED GROUNDWOOD PAPER*

	1992e	1991e	1990r	1989r	1988	1987	1986	1985
U.S.								
Production, 000 tons	1,812	1,788	1,768	1,743	1,624	1,498	1,540	1,521
Capacity[1], 000 tons	1,929	1,920	1,924	1,874	1,735	1,653	1,685	1,644
Utilization rate, %	93.9	93.1	91.9	93.0	93.6	90.6	91.4	92.5
Imports, 000 tons	2,631	2,439	1,338	1,304	1,404	1,270	1,028	1,027
Exports, 000 tons	92	87	75	88	66	56	41	37
Apparent U.S. consumption								
000 tons	4,351	4,140	3,031	2,959	2,962	2,712	2,527	2,511
lb/capita	32.08	32.95	24.37	24.04	24.01	22.31	20.98	21.05
000 tons/billion $ real GNP (1982)	1.00	0.98	0.73	0.72	0.74	0.70	0.68	0.69
CANADA[2]								
Production, 000 tons	2,118	2,076	1,959	1,840	1,628	1,477	1,343	1,146
Capacity, 000 tons	2,472	2,312	2,072	2,032	1,664	1,499	1,391	1,146
Exports, 000 tons	1,764	1,729	1,695	1,527	1,382	1,256	1,138	992
Utilization rate, %	85.7	89.8	94.5	90.6	97.8	98.5	96.5	100.0

*All tons are short tons.
e = Estimate.
r = Revised.
1. American Paper Institute.
2. Canadian Pulp & Paper Assn.

cal) and kraft (chemical) pulp. Uncoated groundwood papers start at a brightness level of 64 Elrepho and go as high as 72, whereas newsprint brightness falls between 56 and 62 and coated groundwoods are in the low to mid-70s.

Newsprint mills were the first candidates to produce groundwood papers, encouraged, in part, by the high value of the product. Other contributing factors were Canadian newsprint overcapacity, an unfavorable U.S./Canada dollar exchange rate, changes in the newspaper publishing industry, such as the emphasis on better-quality printing (as with *USA Today*), and fewer newspapers around the continent. Large newsprint mills became the first major producers of groundwood papers, often by converting older newsprint machines, still a trend in Canada. New machines installed specifically for uncoated groundwood paper production (rather than conversion from newsprint) include Lake Superior Paper Industries at Duluth, Minn., Stone-Consolidated Inc., Grand'Mère, Que., and St. Marys Paper Inc., Sault Ste. Marie, Ont. Newsprint machines are upgraded to uncoated groundwood by adding fillers, using more chemical furnish, adding formation process improvements (top-wire formers), and adding on-machine calendering or off-machine supercalendering. Basis weights range from 18 to 40 lb (24 x 36 in., 500 sheets) or 30 to 66 g/m^2. About 70% of the SC paper consumed is printed on rotogravure presses.

SC papers were pioneered by Scandinavian mills and succeeded in finding a place in the European magazine market, something they have not done nearly as well in the North American market. SC papers are generally classified in three grades: unfilled SC-C (essentially a higher-quality newsprint), low-filled SC-B, and high-filled SC-A, which is the grade that competes most directly with coated groundwood No. 5 paper in magazines and catalogs. Three projects are focusing on machine-finished (MF) coated paper, a grade in between SC and lightweight coated (LWC) ground-

U.S. PRODUCTION AND CAPACITY FOR UNCOATED GROUNDWOOD PAPER

(000 short tons)

	Production		
Year	**Census**	**API[1]**	**Capacity[2]**
1993	—	—	1,933
1992	—	—	1,929
1991	—	—	1,920
1990	—	1,768	1,924
1989r	1,764	1,743	1,874
1988	1,647	1,624	1,735
1987	1,485	1,498	1,653
1986	1,539	1,540	1,685
1985	1,521	1,521	1,710
1984	1,565	1,565	1,622
1983	1,604	1,531	1,642
1982	1,499	1,471	1,655
1981	1,428	1,471	1,625
1980	1,538	1,499	1,624
1979	1,800	1,509	1,537
1978	1,636	1,354	1,453
1977	1,589	1,360	1,367
1976	1,560	1,321	1,309
1975	1,294	1,127	1,329
1974	1,411	1,192	1,280
1973	1,416	1,181	1,403
1972	1,308	1,126	1,442
1971	1,186	1,089	1,363
1970	1,214	1,085	1,230
1969	1,208	1,095	1,296

r = Revised.
1. Shipments.
2. American Paper Institute "Capacity Survey," 1990.
Sources: American Paper Institute, Bureau of the Census, *Pulp & Paper Forecaster.*

UNCOATED GROUNDWOOD PAPERS TYPICAL GRADE STRUCTURE

Grade	**Basis weight[1]**
Rotogravure[2] (standard, premium, high brightness)	33, 35 lb (25 x 38 in., 500 sheets)
Offset[2] (premium, high brightness)	28, 35, 38, 45 lb (25 x 38 in., 500 sheets)
Magazine (gravure, offset)	35 lb (25 x 38 in., 500 sheets)
Paperback/book	35, 37 lb (25 x 38 in., 500 sheets)
Directory (white, yellow)	20, 22.5 lb (24 x 36 in., 500 sheets)
Computer	15, 18 lb (17 x 22 in., 500 sheets)

1. Typical weights offered by producers. Other weights may be available.
2. Catalog grades.

GPO MINIMUM ACCEPTABLE PROPERTIES FOR GROUNDWOOD PAPER FORMS

Basis weight				
lb*	12	15	18	20
g/m^2	45	56	68	75
Burst	7	8	11	14
Opacity, %	80	80	80	80
Caliper				
0.001 in.	2.8	3.5	4.2	4.6
mm	0.071	0.089	0.109	0.117

* Ream size: 17 x 22 in., 500 sheets.

wood developed in Scandinavia and Europe: Malette and Rexfor, Quebec's forestry agency, at the former St-Raymond Paper Inc. mill in St-Raymond, Que., 70,000 metric tpy, startup in 1992; Orenda Forest Products in British Columbia, 173,000 metric tpy, startup in 1993-94; and Tembec Inc. at its BCTMP mill in Temiscaming, Que., 200,000 metric tpy, startup in 1995. Tembec is studying the possibility of making that machine standard coated groundwood as well.

The largest North American producers of SC papers are Abitibi-Price Inc., Jonquière, Que., 70,000 tpy; Lake Superior, a project of Pentair Inc. and Minnesota Power, 240,000 short tpy; Champion International Corp., Sartell, Minn., 80,000 tpy; Madison Paper Industries, Madison, Maine, 175,000 tpy; and St. Marys Paper, 185,000 tpy.

In 1980, total North American consumption of SC paper stood at about 300,000 short tons, of which 65% was clay-filled, that is, SC-A or SC-B grades, according to Mario J. Albanese, executive director of the SC Council. Annual consumption is now pegged at 1.5 million tons, of which 90% is clay-filled. About 65% of the SC paper consumed is produced in North America, and the rest is imported from Europe and Scandinavia. In fact, offshore capacity will increase 1 million tons by 1993, bringing worldwide capacity to over 5 million short tons, Albanese said. More importantly, SC will maintain the strong growth experienced in recent years, assuming the economy picks up as expected. Albanese forecasts a minimum 3% annual growth and maybe 6% in 1992-94.

SC papers have a clay content ranging from almost nothing to 25% or more. Clay (kaolin) and other pigments enhance appearance by adding brightness, opacity, strength, and bulk. Use of kaolin pigments in groundwood papers has grown because of advertiser demands for better paper quality, according to C.D. Richardson, director of sales in the U.S. and Canada for Engelhard Corp. Richardson said that SC papers have basis weights ranging from 41 to 82 g/m^2 (26 lb to 55 lb) and contain at least 50% mechanical pulp, with the balance made up of chemical fiber. Filler content is usually between 15% and 30%. As with other papers grades, the trend is toward lighter basis weights (26 to 34 lb) because of recent postal rate increases.

Among a number of papermaking improvements, the hottest thing is soft calendering (as compared with "hard" calendering), which is designed to improve smoothness and printability. These "smooth" papers will grow 8% to 10% annually during the next five to ten years—far more than any other groundwood grade and even more than the 5% to 6% expected for LWC papers.

END-USE TRENDS

Uncoated groundwood grades are used in a variety of products. Estimated 1991 demand for these products is as

TOP NORTH AMERICAN PRODUCERS OF UNCOATED GROUNDWOOD

	Company	Annual capacity (000 short tons)	Market share (%)
1.	Stone-Consolidated	490	11.6%
2.	MacMillan Bloedel[1]	460	10.9
3.	Abitibi-Price	440	10.4
4.	Canadian Pacific Forest Products	420	9.9
5.	Champion International	355	8.4
6.	Georgia-Pacific Corp.[2]	270	6.4
7.	St. Marys Paper	270	6.4
8.	Boise Cascade	265	6.3
9.	Lake Superior Paper	240	5.7
10.	Kruger	237	5.6
11.	Domtar	190	4.5
12.	Madison Paper	185	4.4
13.	Daishowa America	155	3.7
14.	James River	148	3.5
15.	Fraser[1]	145	3.4
16.	Kimberly-Clark	90	2.1

Market share of top five companies: 51.2%
Market share of top ten companies: 81.5%
North American capacity (1991): 4,232 million tons
U.S.: 1,920; Canada: 2,312

1. MacMillan Bloedel Ltd. and Fraser Inc. owned by Noranda Forest Inc.
2. (Great) Northern Paper Div., Millinocket, Maine.

UNCOATED GROUNDWOOD PAPERS: CANADIAN PRODUCTION, EXPORTS, AND CAPACITY

(000 short tons)

Year	Production[1]	Exports[2]	Capacity[1]
1992e	2,118	1,764	2,472
1991e	2,076	1,729	2,312
1990r	1,959	1,695	2,072
1989r	1,840	1,527	2,032
1988	1,628	1,382	1,664
1987	1,477	1,256	1,499
1986	1,343	1,138	1,391
1985	1,146	992	1,146
1984	1,000	845	1,020
1983	843	575	882
1982	715	460	827
1981	711	320	728
1980	677	305	728
1979	625	321	702
1978	580	266	675
1977	463	193	560
1976	363	133	480
1975	315	140	402
1974	401	183	440

e = *Pulp & Paper* estimate for production and exports.
r = Revised.
1. Canadian Pulp & Paper Assn.
2. Statistics Canada.

follows: catalog, 500,000 tpy; directory, 690,000 tpy; newspaper inserts and direct-mail advertising circulars, 1.3 million tpy; periodicals (magazine and Sunday supplements), 620,000 tpy; business papers, including forms and carbonless basestock, 400,000 tpy; and miscellaneous (books, basestock for converting, and exports), over 1.2 million tpy.

In 1990, approximately 13.6 billion catalogs were mailed in the U.S., according to the Direct Marketing Assn. That figure is up from 11.1 billion five years earlier and 5.8 billion in 1980. The primary catalog publishers include large retailers, such as Sears, Roebuck & Co., Spiegel, and J.C. Penney, and a variety of 6,500 specialty stores (such as office supply), mail-order houses, and other merchandisers. About 25% (375,000 tons) of the SC paper produced goes into catalogs, out of a total 2.8 million tons of paper used in catalogs. Thus, SC paper represents approximately 13% of paper used in catalogs. About 5% is other uncoated groundwood, such as MF, and 70% (about 1.9 million tons) is coated, of which 38% is coated No. 5 and 40% coated Nos. 3 and 4. The remaining 12% is a combination of other coated grades and a small amount of uncoated free-sheet.

UNCOATED GROUNDWOOD PAPER: U.S. EXPORTS AND IMPORTS

(000 short tons)

Year	Exports[1]	Imports[2]
1990	75	1,338
1989r	88	1,304
1988	66	1,404
1987	56	1,270
1986	41	1,527
1985	37	1,387
1984	30	1,298
1983	37	920
1982	56	653
1981	120	650
1980	101	688
1979	80	695
1978	58	611
1977	54	443
1976	71	338
1975	74	84
1974	53	110
1973	29	120
1972	18	142
1971	10	156
1970	7	218

r = Revised.

[1] Prior to 1978, Census classification was groundwood paper, printing/writing and converting, uncoated. From 1978, classification was printing/writing papers, over 10% mechanical pulp, uncoated.

[2] Prior to 1978, Census classification was uncoated book and printing paper with over 25% mechanical pulp. From 1978, classification was the same except for mechanical pulp content, which was reclassified as over 10% mechanical pulp.

Source: Bureau of the Census.

Either rotogravure or offset can be used for catalog printing, but gravure is favored for longer runs for economies of scale. Publishers can switch between grades, especially from SC to coated groundwood but also from LWC paper to coated free-sheet, to enhance appearance. But some trade down from coated groundwood to SC or even MF paper or newsprint to save costs. Uncoated groundwood catalog paper is similar to lightweight newsprint or telephone directory paper, but it has been hurt by competition from SC. Some mass marketers still use lower-quality grades, such as high-brightness newsprint and standard or lightweight newsprint, when image quality is not important (e.g., J.C. Whitney & Co. Inc.'s auto parts catalog).

Telephone directory paper has a lower gloss and brightness than catalog paper, and for telephone books, it is generally made with a 22- to 23-lb basis weight (65% of the total paper), with 20-lb and even 18-lb paper getting more use since they reduce bulk and weight. About 13% of the paper is heavier than 22.5 lb. There are more than 200 directory publishers, according to Charles H. Vessey, specialist-paper purchasing with Southwestern Bell *Yellow Pages*. *Yellow Pages* directories represent about 6.8% of U.S. advertising dollar volume, placing fourth after newspapers, television, and direct mail. Directory revenues are growing at about 6.5% to 7%/year, Vessey indicated. Competition in the directory business, especially with *Yellow Pages* directories, has encouraged publishers to add special sections on better-quality paper—SC, uncoated free-sheet, and even coated papers. However, these alternative papers currently account for only about 50,000 tons, compared with a total of 782,000 tons.

The Regional Bell Operating Companies—the spin-offs created under the breakup of American Telephone & Telegraph in the 1980s—will use about 60% of the white and yellow directory paper in 1991 (close to 62% of total paper

LIGHTWEIGHT (CATALOG/DIRECTORY) PAPER CAPACITIES IN NORTH AMERICA*

(000 short tons)

Company	Capacity	Mill producing
MacMillan Bloedel[1]	230	Port Alberni, Powell River, B.C.
Daishowa	180	Port Angeles, Wash.; Quebec City, Que.
Georgia-Pacific	170	Millinocket, Maine
Fraser[1]	135	Madawaska, Maine
Abitibi-Price	107	Alma, Jonquière, Que.
Champion International	90	Lufkin, Texas; Deferiet, N.Y.
Stone-Consolidated[2]	70	Trois Rivières, Que.
James River[3]	25	Clatskanie, Ore.

*1991 estimated.

[1] Owned by Noranda Forest Inc.

[2] Also has swing capacity on other machines.

[3] *Pulp & Paper* estimate; total machine capacity is 140,000 tpy.

Sources: Company data; *Pulp & Paper* estimates.

used is yellow). Total directory paper use is growing about 2.5%/year, Vessey explained.

Few North American magazine publishers are yet willing to use SC paper, as opposed to European publishers, who have taken to SC with gusto. SC is popular in North America for advertising inserts, flyers, other periodicals, and newspaper supplements. One estimate suggested that about 277,000 tons of SC paper were used for Sunday magazines and supplements, much of it by the *New York Times*. Other periodicals that use SC include *Rolling Stone*, *Spin*, *Soap Opera Digest*, and *Guideposts* magazine. Inserts and flyers consumed about 541,000 tons, and catalogs used 325,000 tons. The remainder, about 62,000 tons, went to book publishers and commercial printers for jobs other than inserts/flyers.

The groundwood forms market is estimated to be as high as 250,000+ tpy, but Edward W. Ahern, director of marketing at Abitibi-Price Sales Corp., said his company estimates the groundwood forms segment to be no more than 150,000 tpy. Groundwood forms represents 6.7% of total U.S. demand for uncoated groundwood papers and 7.3% of U.S. demand for business forms. Groundwood forms paper demand is expected to either remain flat or decline as various electronic technologies, such as intelligent copiers/printers and laser printers, eat into the overall forms market (see Uncoated Free-sheet chapter). One estimate put groundwood paper as about 5.8% of total paper consumed (less than 200,000 tons) by forms converters.

Ahern said that for groundwood forms grades to gain market share, they will have to adapt to the new technologies and become "business" papers rather than "forms" papers. However, there may be a role for blended sheets, such as the one Abitibi is making at its Beaupre, Que., mill. This sheet has an 80 brightness, which is higher than standard groundwood forms but slightly less than most free-sheet forms bond. It can replace free-sheet forms bond in applications that do not require archival quality—at a price attractively below free-sheet. Groundwood forms papers are priced as much as $200/ton less than free-sheet forms bond. The blended grade is priced in between groundwood and free-sheet.

Groundwood-based forms papers are divided into three categories: 1) Low-content groundwood papers. These contain from 10% to 50% groundwood fiber and have brightness levels ranging from 72 to 77. They are similar to uncoated free-sheet and forms bond in appearance and performance when used in computer applications and are used instead of register bond in stock continuous forms. Colored papers in this grade sometimes are substituted for colored free-sheet papers; 2) Papers with over 50% groundwood content and a low brightness level of 65. These papers make up the largest group; and 3) Papers used as base-

UNCOATED GROUNDWOOD EXPANSIONS

Company	Location	Annual short tons	Startup	Nature of work
Abitibi-Price	Alma, Que.	65,000	1988	Convert to LW catalog and directory
St. Marys Paper	Sault Ste. Marie, Ont.	172,000	1988	Build new SC machine
F.F. Soucy	Rivière-du-Loup, Que.	22,000	1989	Rebuild news/groundwood machine
Kruger	Trois Rivières, Que.	30,000	1989	
Stone-Consolidated	Trois Rivières, Que.	33,000	1989	
Stone-Consolidated	Grand'Mère, Que.	125,000(net)	1990	New specialties machine
Kruger	Corner Brook, Nfld.	77,000	1990	Convert No. 4 newsprint machine to unfilled and low-filled SC
Boise Canada	Fort Frances, Ont.	49,600	1990	Ugrade mill to raise groundwood specialties capacity
Fletcher Challenge	Campbell River, B.C.	22,000	1990	Upgrade No. 2 newsprint machine to soft calendered SC-B equivalent
Daishowa America	Port Angeles, Wash.	150,000	Postponed	Build new directory machine
Lake Superior Paper	Duluth, Minn.	245,000	Proposed	Second SC machine
Madison Paper	Madison, Maine	170,000	Canceled	New SC machine
Madison Paper	Madison, Maine	n.a.	Under study	Rebuild two supercalenders; may add recycled fiber capacity
Smurfit	Oregon City, Ore.	n.a.	Under study	May convert one or more newsprint machines to MF and SC papers

North American capacities, 1991
U.S. (American Paper Institute): 1.920 million short tons
Canada (Canadian Pulp & Paper Assn.): 2.312 million metric tons

n.a. = Not available.
LW = Lightweight.
SC = Supercalendered.
Sources: *Pulp & Paper Week*, *Pulp & Paper Project Report*

stock for carbonless forms. Called low-ply chemical carbonless papers, they range in brightness from 70 to 74 and are used primarily for multiple-part stock continuous forms.

PRODUCTION/CAPACITY

Canada remains the largest North American source of uncoated groundwood papers, but U.S. mills are catching up fast. Many Canadian mills have converted newsprint machines to groundwood grades, while many of the machines in the U.S. are newer and designed specifically for groundwood, usually SC. Much of the Canadian tonnage was shipped to the U.S., as was newsprint. Both Canadian and U.S. production of uncoated groundwood papers increased over the last couple of decades.

U.S. mills shipped about 1.2 million tons in 1973. This figure jumped to 1.5 million tons in 1983 and is projected at 1.77 million tons in 1990 and 1.79 million tons in 1991, according to the American Paper Institute. Canadian mills produced about 319,000 short tons in 1973, compared with 843,000 tons in 1983 and an estimated 1.96 million tons in 1990 and 2.08 million tons in 1991. Canada's figures are probably too low because of some groundwood grades being classified as newsprint. Most estimates put that additional tonnage at 200,000 tons or more. The classifications were changed to gain the duty-free status of newsprint, but the Canada-U.S. Free Trade Agreement eventually eliminates duties on groundwood grades, and the industry will likely reclassify the tonnage at a future date.

U.S. uncoated groundwood capacity was about 1.4 million tons in 1973, 1.6 million tons in 1983, and an estimated 1.92 million tons in 1990 and 1991. Canadian mills had capacity for 412,000 tons in 1973, 882,000 tons in 1983, and an estimated 2.1 million tons in 1990 and 2.3 million tons in 1991. Again, Canadian capacity is probably 200,000 tons or more higher than industry figures.

Little major new capacity is scheduled to come online in the next few years. Stone-Consolidated started up its new soft-nip machine at Grand'Mère. Kruger Inc. is converted a small newsprint machine to SC at Trois Rivières, Que. But Lake Superior postponed the addition of a second, 240,000-tpy SC machine at Duluth because of weaker market conditions and other factors, and Madison Paper Industries did the same with a proposed expansion. Most additional tonnage will come from improvements of existing groundwood machines and conversions of small machines. And most new capacity will be in Europe/Scandinavia.

OUTLOOK

European producers will be trying to sell paper in the U.S. because of increasing overcapacity of publication papers, according to the 1991 capacity survey by the European Paper Institute (EPI). Most of the survey's conclusions use capacity figures for projects already under construction, which leaves the question of how much planned capacity not yet under construction will be brought into operation by 1995.

SC magazine paper will surpass coated grades as the growth leader of the three major sectors, with capacity expected to rise 28.3% from 1991 through 1995, an increase of 887,000 metric tons. SC capacity will reach 4.021 million tons by 1995, EPI reported. However, deliveries are predicted to advance less than 3%/year, representing just 80% of capacity—3.129 million tons—in 1995, the EPI survey said.

Capacity for coated papers is projected at 6.398 million metric tons in 1995, an 11.6% increase over five years. Deliveries for rolls of coated mechanical papers are forecast to rise 5%/year to 5.452 million tons, or about 85% of capacity. Still, demand is expected to be high enough to substantially absorb the new capacity.

Newsprint, which will represent 9.595 million metric tons of capacity in 1995, will advance 5.5%, or 500,000 tons, over the same period. As with coated grades, demand generally will be strong enough to account for much of the capacity increases, with deliveries in 1995 representing approximately 93% of capacity. Growth in deliveries is projected at 3%/year for the five-year period.

Other grades of uncoated mechanical papers, which represent a small portion of the total publication papers market, will advance 47.2% to hit 976,000 tons in 1995, EPI reported. This is a five-year increase of 313,000 tons. Deliveries will grow at about 1.5%/year for the period. But, as with SC papers, capacity already under construction is likely to be in excess of the expected growth in deliveries, which should be at about 85% of capacity in 1995.

Perhaps even more important than the European overca-

NEW AND PROPOSED NORTH AMERICAN SUPERCALENDERED CAPACITY

Company	Mill	Capacity (000 short tons)	Date
Canadian Pacific Forest Products	Trois Rivières, Que.	70	1987
Abitibi-Price	Jonquière, Que.	65	1987
Lake Superior Paper[1]	Duluth, Minn.	240	1987
St. Marys Paper	Sault Ste. Marie, Ont.	131	1988
Madison Paper	Madison, Maine	182	1988-89
Stone-Consolidated	Grand'Mère, Que.	202	1990
Kruger Inc.	Trois Rivières, Que.	70	1991
Lake Superior Paper[2]	Duluth, Minn.	240	Delayed
Madison Paper	Madison, Maine	n.a.	n.a.

n.a. = Not available.

1. Joint venture of Pentair Inc. and Minnesota Power.

2. Proposed second machine.

pacity is the fact that North American society—particularly in the U.S.—is undergoing major structural changes that will affect paper use for the long term. The U.S. population is virtually at zero overall growth, said Roman Hohol, a pulp and paper consultant with the Strategic Services Div. of H.A. Simons Ltd. Speaking at the Fifth Groundwood Papers Conference, Hohol said that several demographic and societal factors will have an impact on paper use:

•An aging population. "The demographic and physiological effects of aging cannot be ignored by advertisers, media planners, and papermakers," Hohol said.

•Ethnic explosion. "The ethnic makeup of the U.S. is undergoing fundamental change." For instance, Asian Americans make up less than 3% of the population but are the country's fastest-growing and most affluent minority group. Hohol quoted demographer Leon Bouvier, who suggested that if nonwhite populations continue their current growth pattern, whites will be a minority by 2060, affecting products and services and the way information is distributed.

•Women in the workplace. "Increases in [the number of] working women have been one of the key contributing factors in the phenomenal growth of catalogs in the 1980s."

•Increasing adult illiteracy. "Certain printed products may become obsolete unless this problem is solved."

•Growing public apathy. "Increasing indifference on the part of tomorrow's newspaper and magazine readers is cause for great concern." A Times-Mirror study in 1990 indicated that Americans ages 18 to 30 know less and care less about news and public affairs than any other generation since the end of World War II.

•Increasing divorce rate and breakdown of families. "This will lead to the creation of more single-parent households."

•Concentration of wealth. About 75% of U.S. wealth is currently controlled by the oldest 20% of society, while in Canada approximately 50% of all personal assets are held by people age 50-plus. Over the next 25 years, an older generation of North Americans will pass trillions of dollars to a generation of inheritors, causing a "massive redistribution of wealth [that] is expected to have staggering economic implications."

•Death of the mass market. "Niche marketing is here to stay," such as specialized retailers and magazines.

•Environmental concerns. "Society will be less tolerant of wasteful practices, and environmental issues will profoundly shape future economic and social development."

•Globalization. "The structural changes occurring in North America must be viewed in the context of a changing global order."

The meaning here is not that paper use will decline but that uses of paper and types of paper will change over the next 20 years, Hohol said. In fact, printing paper consumption is expected to exhibit healthy growth in the 1990s and beyond.

Separately, Hohol forecasts compound annual growth in consumption of uncoated groundwood papers to rise about 3.5% to 3.7%/year, compared with 4.2%/year for coated groundwood and 0.7% to 1%/year for newsprint.

A retail study by the Graphics Arts Marketing Information Service, completed in late 1991, indicated that paper demand by retailers, excluding coupon merchandisers and consumer goods manufacturers, will decrease slowly over the next decade. And grades will become increasingly polarized based on positioning of retailers. For example, upscale retailers will continue to use a higher percentage of SC and coated grades. Discounters and "deep" discounters will

CANADIAN UNCOATED GROUNDWOOD PAPER EXPORTS

(short tons)

Destination	1988*	1987	1986	1985	1984	1983	1982	1981	1980
U.K.	77,100	23,590	n.a.	n.a.	n.a.	505	n.a.	7,325	9,432
Benelux	2,507	n.a.	n.a.	n.a.	30	n.a.	n.a.	n.a.	1,549
Hong Kong	8,619	1,867	3,695	3,188	2,876	1,226	2,867	4,285	7,484
Singapore	5,153	0	n.a.	n.a.	n.a.	n.a.	2,078	3,972	2,773
Japan	57,764	132	56	10,556	10,647	9,248	n.a.	23	n.a.
Philippines	n.a.	0	n.a.	n.a.	13	n.a.	1,739	1,842	1,312
Thailand	4,422	0	n.a.	1,688	2,574	483	786	n.a.	1,595
Other Asia[1]	39,106	n.a.	n.a.	43	142	110	1,068	109	572
Australia	9,976	2,127	1,216	2,798	4,161	2,331	8,189	3,387	18,434
Colombia	6,188	0	1,351	2,244	1,922	2,752	1,571	4,087	2,101
Venezuela	30,835	11,381	n.a.	n.a.	n.a.	1,217	n.a.	981	n.a.
Other Latin America[1]	10,960	n.a.	1,348	1,150	720	1,387	1,652	794	1,070
U.S.	1,203,242	737,685	658,129	544,212	695,312	556,048	439,338	292,460	258,768
Total	1,504,181	780,400	665,862	566,473	718,637	575,307	459,288	318,265	305,090

*Changed to harmonized system in 1988. New data not available after 1988.
n.a. = Not available.
1. Not necessarily same countries each year.
Source: Statistics Canada (commodity class 351-49 to 1987, HS 4802.60 in 1988).

still use newsprint and lower-value groundwood grades.

In addition, by the late 1990s, papermakers will have significant opportunity to sell quality grades containing postconsumer waste fiber, although the use of recycled paper is still a developing market in this sector, the study said.

Pulp & Paper Forecaster projects that SC will grow at 3.4%/year in the 1991-2000 period, groundwood forms consumption will decline 4.5%/year, directory papers will advance just 1.0%/year, and other grades will gain 1.2%/year. Another way to look at the market is end use as a percentage of total demand. Books will account for 6.0% of the total in 1991 but will drop to 4.5% in 2000, advertising inserts and flyers will increase from 35.2% to 42.8%, and catalogs will go from 12.8% to 13.1%. Directories, at 16.7% in 1991, will drop to 13.1% in 2000; forms converting, at 6.7%, will fall to 3.2%; magazines and periodicals, at 15.3%, will decline to 14.8%; commercial printing, at 6.4%, will rise to 7.8%; other converters, at 0.5%, will slow to 0.2%; and other uses will stay at 0.4%.

UNCOATED GROUNDWOOD PAPERS: U.S. PRICE HISTORY

($/ton)

Year	Directory[1] (22.5-lb white)	SC-A (34-lb)	Premium roto news	Forms 15-lb	MF offset 35-lb
1991					
3Q	$(750)/850*	$(800)/830*	$(660)/745*	$580*	$(610)/655
2Q	$(750)/850*	$(800)/830*	$(660)/745*	$560*	$(600)/655
1Q	(750)/850*	(800)/830*	(690)/745*	(575)/615	(635)/655
1990					
4Q	(800)/850	(800)/830*	(690)/745*	(575)/615	(635)/655
3Q	(800)/850	(800)/830*	(690)/745*	(575)/615	(635)/655
2Q	(730)/780*	(800)/830*	(635)/675	680-720	(635)/675
1Q	(730)/780*	830*	(635)/675	680-720	(635)/675
1989					
4Q	(730)/780*	830*	(635)/675	680-720	(635)/675
3Q	(730)/780*	830*	(635)/675	680-720	(635)/675
2Q	850*	830*	680*	680-720	675*
1Q	850	830	680	720	675*
1988					
4Q	850	830	680	720	675
3Q	780	830	680	690/700	660
2Q	780	780	680	690/700	660
1Q	750	780	652	640	652
1987					
4Q	720	740	600-620	600	575-585
3Q	703	710	553	560	577
2Q	670	670	517	540	570
1Q	(620)/670*	670	517*	540	535*
Year end					
1986	670	710	570	540	535*
1985	670	780*	540	500*	542
1984	670	735	560	500	520
1983	650	645	540	n.a.	n.a.
1982	650	635	515/520	n.a.	n.a.
1931	578	n.a.	500/515	n.a.	n.a.
1980	535	n.a.	475	n.a.	n.a.
1979	480	n.a.	404	n.a.	n.a.
1978	420	n.a.	350/375	n.a.	n.a.
1977	n.a.	n.a.	330	n.a.	n.a.

*Discounting off list price.
( ) = Common transaction price.
n.a. = Not available.
1. Reflects open market sales, not contract tonnage to Regional Bell Operating Companies.
Sources: *Pulp & Paper Week; Pulp & Paper Pricebook2.*

Paper:

COATED

Coated papers are categorized into a variety of divisions and subdivisions for a growing number and type of printing needs. Coated papers are first broken down as being either coated one side (C1S) or coated two side (C2S). Next, they are categorized according to pulp content, i.e., whether they contain mechanical (groundwood) pulp or chemical (free-sheet or woodfree) pulp. Paper with 10% or more mechanical pulp is designated coated groundwood; paper with less than 10% is coated free-sheet. The term "lightweight coated" (LWC) is often used interchangeably with "coated groundwood," although basis weights often range beyond the lightweight area, such as 40 lb or 45 lb. In addition, some paper companies are coming out with coated free-sheet grades they call LWC. Essentially, mills can classify papers as they wish, and the lines between grade classifications are becoming blurred with the increased use of thermomechanical pulps (TMP) and chemi-thermo-mechanical pulps (CTMP) and other developments.

C1S paper is generally declining in use as mills add more modern on- and off-machine coaters that easily coat both sides and, more importantly, as demand for C2S applications grows along with the increased emphasis on graphics. However, C1S paper production did pick up some ground in 1990, with production up almost 2% compared with 1989 (which itself saw a decline of 2% from 1988). C1S paper is about 6% of the total U.S. coated paper market and 13% of coated free-sheet production. About 85% of C1S paper is used for labels; the rest is divided among books,

U.S. COATED PAPER PRODUCTION

(000 short tons)

Year	Total coated[1]	Coated one side[2]	Coated two side[2] Total	Nos. 1-4	No. 5
1990	7,522	424	7,098	3,438	3,660
1989r	7,215	415	6,779	3,246	3,533
1988r	7,359	423	6,941	3,325	3,616
1987	6,859	422	6,437	3,117	3,320
1986	6,260	385	5,875	2,755	3,120
1985	5,860	360	5,500	2,520	2,980
1984	6,249	390	5,860	2,670	3,190
1983	5,675	390	5,285	2,320	2,965
1982	4,970	365	4,605	2,025	2,580
1981	4,880	395	4,485	2,035	2,450
1980	4,615	375	4,240	1,840	2,400
1979	4,642	410	4,230	2,080	2,150
1978	4,593	440	4,155	2,000	2,155
1977	4,274	415	3,860	1,640	2,220
1976	3,890	410	3,480	1,490	1,990
1975	3,076	330	2,740	1,120	1,620
1974	3,739	410	3,330	1,650	1,680
1973	3,757	435	3,320	1,430	1,890
1972	3,455	400	3,055	1,040	2,015
1971	3,165	360	2,805	905	1,900

r = Revised.

1. Shipments for both one- and two-side coated papers.

2. *Pulp & Paper* estimate. May not add to "Total coated" due to rounding.

commercial printing, business forms, envelopes, and converted products other than labels. C2S papers are used primarily for magazines, catalogs, advertising brochures and inserts, and other commercial printing.

In addition to the C1S/C2S and pulp content groupings, coated papers are broken down further into number grades, ranging from No. 1, which is premium and superpremium (actually above No. 1) coated free-sheet, to No. 5, the lowest in quality and price. Superpremium and Nos. 1 to 3 are made from chemical pulps (free-sheet), although a few thousand tons of No. 3 groundwood are produced each year. About 55% of No. 4 paper production is classified as coated groundwood, and about 93% of No. 5 produced in 1990 was coated groundwood, although the amount of No. 5 coated free-sheet is on the rise. No. 5 papers represent just under 50% of the total 1990 coated paper production of 7.5 million tons.

The higher the grade level, the fewer tons produced. In 1990, No. 1 was 6% of total U.S. coated paper production. No. 2 was almost 8%, No. 3 about 12%, No. 4 free-sheet just under 9%, No. 4 groundwood about 11%, No. 5 free-sheet 3%, and No. 5 groundwood more than 45%.

For many years, Canadian mills took a backseat to their U.S. counterparts in coated paper production. In the second half of the 1980s and the early 1990s, however, Canadian producers not only have been adding capacity of both coated free-sheet and coated groundwood but also have shown their paper to be of equal quality. Perhaps even more interesting is the fact that three companies now plan to produce the new machine-finished (MF) coated grades first devel-

U.S. STATISTICS FOR COATED FREE-SHEET PUBLICATION PAPERS*

	1991e	1990	1989r	1988	1987	1986
Production,[1] 000 tons	3,409	3,157	3,155	3,200	3,085	2,781
Capacity,[2] 000 tons	4,023	3,638	3,503	3,436	3,229	2,944
Utilization rate, %	84.7	86.8	90.1	93.1	95.5	94.5
Imports, 000 tons	288	276	235	119	114	100
Exports, 000 tons	85	77	51	62	57	42
Apparent U.S. consumption						
000 tons	3,612	3,356	3,339	3,257	3,142	2,839
lb/capita	28.61	26.85	27.00	26.40	25.85	23.58
000 tons/billion $ real GNP (1982)	0.86	0.81	0.81	0.81	0.82	0.76

*All tons are short tons.
e = Estimate.
r = Revised.
1. *Pulp & Paper* estimates.
2. American Paper Institute survey.

TYPICAL PROPERTIES OF COATED PUBLICATION GRADES

General characteristics	Typical use	Basestock	Coating	Brightness
No. 1: Enameled, double-coated, hand-sorted expensive base and coating; high gloss; basis weight above 70 lb	Annual reports	High-brightness chemical pulp; heavily filled	High in TiO_2; high gloss enameled; synthetics	82-88
No. 2: Double-coated, expensive base and coating	Expensive advertising	High-brightness chemical pulp; filled (clay)	High in TiO_2; some clay; synthetics	78-82
No. 3: Single- or double-coated, lower-quality basesheet	Advertising, upscale catalogs and magazines	Chemical pulp; minor amounts of groundwood	Mostly clay, some TiO_2 less expensive	76-82
No. 4: Lower cost, lower brightness	Magazines, catalogs	Groundwood and chemical pulp; some clay filler	Less expensive; coating—clay and TiO_2	72-78
No. 5: Lower basis weight, high groundwood content	Directories, catalogs, magazines	Mostly groundwood or TMP, chemical pulp for runability	Variable, some contain synthetics	68-72

oped in Scandinavia and Europe. By the end of 1990, Canadian mills produced an estimated 578,000 metric tons of coated printing and writing paper, an almost 18% increase over the previous year. Most of the increase is accounted for in the startup of Repap Enterprises Corp. Inc.'s new 285,000-short-tpy machine at Miramichi (Newcastle), N.B. This is designated as a swing machine, able to produce either coated groundwood or free-sheet papers. Coated paper now accounts for 16% of Canadian production of printing and writing papers (uncoated groundwood, uncoated free-sheet, and coated).

Basis weights for premium coated grades—Nos. 1 and 2—generally range from 60 to 100 lb. Nos. 3 and 4 are offered in basis weights of 25 to 90 lb. Commercial printers are the biggest users of coated free-sheet—about 63% in 1990. They use these grades for such projects as annual reports, high-class catalogs, other advertising and promotional materials (such as new car brochures), and cover and interior pages of upscale magazines, with some used in coffee table books. In 1990, approximately 17% of No. 3 production went to magazine publishers and 73% went to commercial printers.

Coated groundwood papers are commonly made in the 32- to 50-lb range (25 x 38 in. in reams of 500), although basis weights can run as low as 24 lb and as high as 70 lb. End uses include magazines, Sunday newspaper supplements, catalogs, newspaper advertising inserts, directories, books, and coupon flyers. Coating weight is approximately 30% of total sheet weight for LWC papers.

Different printing methods, such as letterpress, offset, and rotogravure, require paper designed to fit each type of printing, although some papers can run satisfactorily on more than one printing process. Offset printing, particularly heatset, has grown rapidly in importance, and offset papers represent the largest portion of C2S publication papers—between 75% and 80%. Letterpress accounts for less than 10%, and gravure makes up most of the balance.

Offset printing requires a smooth surface and pick resistance. Letterpress is slightly less demanding in terms of paper surface properties but generally needs heavier basis weights because of strike-through in low-basis-weight papers. Gravure printing is often used for long press runs that require paper with a smooth surface and controlled ink receptivity.

Mills installing a new machine or substantially rebuilding existing equipment have the choice of on- or off-machine coating equipment. A smaller, older mill might find it easier to use an off-machine coater that can simply be shut down when the mill needs to make uncoated paper. During the coating process, one station applies coating to one side, although the same station can be used to apply coating simultaneously to both sides. Mills may also have coating equipment that applies two coats on the same side, or a precoat may be applied to smooth out surface roughness. These processes are separate from the coating that a printer may add during or after the printing run. This adds an even glossier surface to the paper (e.g., magazine covers), and it can be done inline (UV) or later, which is more expensive.

Coating solutions are comprised of pigments (kaolin clay, titanium dioxide, or calcium carbonate), binders, and additives to control viscosity and other rheological properties. Delaminated clay is increasingly being used, especially in LWC papers. These coatings provide better runability when combined with conventional kaolins.

Water comprises as much as 50% of a coating formulation, and the excess must be dried quickly and efficiently by through-air, drum, and infrared drying. Once excess water is removed, the coated sheet is supercalendered if a glossy finish is desired, and it may be su-

NORTH AMERICAN STATISTICS FOR COATED GROUNDWOOD PUBLICATION PAPERS*

	1991e	1990	1989r	1988	1987	1986
U.S.						
Production,[1] 000 tons	4,303	4,214	4,059	4,159	3,782	3,478
Capacity,[2] 000 tons	4,553	4,398	4,341	4,347	4,136	3,799
Utilization rates, %	94.5	95.8	93.5	95.7	91.4	91.6
Imports, 000 tons	650	660	539	507	500	401
Exports, 000 tons	150	140	116	46	39	36
Apparent U.S. consumption						
000 tons	4,803	4,734	4,482	4,620	4,243	3,843
lb/capita	38.36	37.81	35.97	37.45	34.91	31.91
000 tons/billion $ real GNP (1982)	1.13	1.14	1.09	1.16	1.10	1.03
Canada						
Production,[1] 000 tons	563	501	377	365	—	—
Capacity,[2] 000 tons	636	546	419	380	—	—
Utilization rates, %	88.5	91.8	90.0	96.1	—	—
Imports, 000 tons	100	98	94	n.a.	—	—
Exports, 000 tons	583	561	422	207	—	—
Consumption, 000 tons	215	207	190	202	—	—

*All tons are short tons.
e = Estimate.
r = Revised.
1. *Pulp & Paper* estimates.
2. American Paper Institute capacity for coated groundwood papers; includes coated grade No. 5 and some No. 4.

percalendered through the nip of many rolls to develop the surface gloss further. If a high-gloss finish is required, as with an enameled sheet, a gloss calender is used. Dull-finish and matte-finish papers are made by curtailing the use of supercalenders. Dull-finish paper gets little or no pressure from the supercalender. Matte-finish paper goes through a supercalender with one stack that has been sandblasted or engraved to imprint the matte appearance. Matte-finish paper gives a gloss test reading of 20 or less, while dull-finish paper can reach 45 or 55 on the gloss scale. Glossy finish is higher. Probably about 90% of C2S paper is glossy, about 10% matte, 3% dull, and a small amount embossed. Between 85% and 90% of coated paper is shipped in rolls rather than sheets.

NORTH AMERICAN COATED PAPER CAPACITY

(000 short tons)

Year	Coated free-sheet	Change (%)	Coated groundwood*	Change (%)
U.S.				
1993p	4,557	3.9%	4,628	0.7%
1992p	4,386	9.0	4,596	0.9
1991p	4,023	10.6	4,553	3.5
1990r	3,638	3.9	4,398	1.3
1989r	3,503	1.9	4,341	-0.1
1988	3,436	6.4	4,347	5.1
1987	3,229	9.7	4,136	8.9
1986	2,944	3.5	3,799	-0.5
1985	2,845	1.9	3,820	1.4
1984	2,791	12.9	3,766	6.9
1983	2,473	8.9	3,522	6.3
1982	2,271	2.1	3,312	8.7
1981	2,225	0.1	3,047	10.3
1980	2,222	0.4	2,762	10.0
1979	2,214	5.6	2,511	2.5
1978	2,096	5.4	2,450	1.7
1977	1,989	4.5	2,408	4.7
1976	1,903	-1.8	2,299	8.1
1975	1,938	—	2,127	-47.8
1974	—	—	4,075	0.7
1973	—	—	4,045	4.6
1972	—	—	3,866	2.3
1971	—	—	3,778	2.1
1970	—	—	3,700	-0.9
1969	—	—	3,732	—
CANADA				
1993e	193	12.9	687	3.9
1992e	171	23.9	661	3.9
1991e	138	8.7	636	16.5
1990	127	-3.8	546	30.3
1989	132	0.0	419	10.3
1988	132	n.a.	380	n.a.

*Includes all coated paper capacity until 1975.
e = Estimate.
p = Preliminary.
r = Revised.
n.a. = Not available.
Sources: American Paper Institute, Canadian Pulp & Paper Assn.

INDUSTRY STRUCTURE

Ten leading coated groundwood producers account for 80% of North American capacity, while in coated free-sheet grades, the top ten mills account for between 90% and 98% of total industry capacity based on recent new machine startups. More than 60% of North American coated paper capacity is controlled by the top five companies. Major coated free-sheet producers are Scott Paper Co., Westvaco Corp., Champion International Corp., Mead Corp., and Consolidated Papers Inc. The five largest coated groundwood producers are Champion, International Paper Co., Consolidated Papers, Repap Enterprises, and Blandin Paper Co. (owned by Fletcher Challenge Canada Ltd.).

A host of coated groundwood projects had been brought online by the end of 1990. Some major additions have been

MAJOR NORTH AMERICAN COATED PAPER PRODUCERS

(1991 estimated capacities, short tons)

		Annual capacity (000 tons)	Capacity share (%)
1.	Champion International	1,230	13.2%
2.	Scott Paper[1,2]	1,100	11.8
3.	Consolidated Papers[1]	960	10.3
4.	Repap Enterprises	859	9.2
5.	Mead	692	7.4
6.	International Paper	670	7.2
7.	Westvaco	590	6.3
8.	Simpson Paper[1]	450	4.8
9.	Boise Cascade	390	4.2
10.	Bowater	350	3.7
11.	Blandin	335	3.6
12.	Potlatch	310	3.3
13.	James River	260	2.8
14.	Pentair[3]	220	2.4
15.	Weyerhaeuser	195	2.1
16.	Noranda Forest	170	1.8
17.	Georgia-Pacific	165	1.8
18.	Papyrus Newton Falls	110	1.2
19.	Abitibi-Price	100	1.1

North American capacity (1991e): 9,350 million tons
Capacity share of top five companies: 51.8%
Capacity share of top ten companies: 74.2%

e = Estimate.
[1] *Pulp & Paper* estimate.
[2] S.D. Warren Div.
[3] Niagara of Wisconsin Paper Corp.
Source: Dean Witter Reynolds Inc., Morgan Stanley & Co., company data, *Pulp & Paper* estimates.

delayed or put on hold because of overcapacity, weaker market conditions, and substantial new capacity in Europe. One delayed project is Boise Cascade Corp.'s 318,000-tpy machine at Rumford, Maine, now scheduled for completion in 1994. Other proposed projects include 250,000-tpy machines at Blandin in Grand Rapids, Minn., and Bowater Inc. in Calhoun, Tenn.; 273,000 tpy formerly proposed as a joint venture between Georgia-Pacific Corp. and Bowater in Millinocket, Maine (now 80% owned by Bowater); 260,000-tpy machines at James River Corp.'s St. Francisville, La., mill and at Consolidated's Wisconsin Rapids, Wis., mill; and an unspecified machine by Fraser Paper Ltd. in Madawaska, Maine. Champion reportedly is studying a project for Sartell, Minn. Three projects are also focusing on MF coated paper, a grade in between uncoated supercalendered (SC) and coated groundwood LWC developed in Scandinavia and Europe. The three projects are as follows: Malette and Quebec's forestry agency, Rexfor, at the former St-Raymond Paper Inc. mill in St-Raymond, Que., 70,000 metric tpy, startup in 1992; Orenda Forest Products in British Columbia, 173,000 metric tpy, startup in 1993-94; and Tembec Inc. at its bleached CTMP mill in Temiscaming, Que., 200,000 metric tpy, startup in 1995. Tembec is studying the possibility of making that machine standard coated groundwood as well.

Coated free-sheet capacity has grown even more substantially, considering the size of the marketplace. Three major projects came online in 1990-91: Champion's 265,000-tpy machine at Quinnesec, Mich., Scott Paper's new 215,000-tpy machine at Skowhegan, Maine, and 212,000 tpy of paper at Consolidated Papers' Wisconsin Rapids Div.

MAJOR NORTH AMERICAN COATED GROUNDWOOD PRODUCERS*

		Annual capacity (000 tons)	Capacity share (%)
1.	Champion International	720	13.9%
2.	International Paper[1]	620	11.9
3.	Consolidated Papers[1]	580	11.2
4.	Repap Enterprises	525	10.1
5.	Blandin Paper[2]	335	6.4
6.	Bowater	325	6.3
7.	Mead	310	6.0
8.	Boise Cascade	285	5.5
9.	James River	260	5.0
10.	Pentair[3]	220	4.2

North American capacity (1991): 5,198 million tons
U.S.: 4.553 million tons
Canada: 645,000 tons
Capacity share of top five companies: 53.5%
Capacity share of top ten companies: 80.4%

*All tons are short tons.
1. *Pulp & Paper* estimate.
2. Subsidiary of Fletcher Challenge Canada Ltd.
3. Niagara of Wisconsin Paper Corp.

Repap has added the most capacity in Canada—both groundwood and free-sheet. Island Paper Mills Co. added a coater at its free-sheet mill in New Westminster, B.C., to produce 75,000 metric tpy. Canadian coated free-sheet capacity in 1990 was approximately 182,000 short tpy based on Island's new coating capacity, swing tonnage at Repap's Miramichi mill, and Abitibi-Price Inc.'s Provincial Papers mill in Thunder Bay, Ont., which also produces some uncoated paper. Coated free-sheet capacity in 1991 was estimated at 182,000 short tpy, climbing to 209,000 tpy in 1992, according to the Canadian Pulp & Paper Assn. Coated groundwood capacity in Canada is much more substantial: 419,000 tpy in 1989, 584,000 tpy in 1990, and 645,000 tpy in 1991, rising in 1992 to 678,000 tpy.

Most of Canada's coated paper ends up with U.S. customers. U.S. imports of Canadian coated grades were about 271,000 short tons in 1989 and 379,000 tons in 1990, a 40% increase, according to CPPA figures.

TRENDS IN LWC PUBLICATION GRADES

As mentioned, LWC papers are usually considered to have basis weights of 40 lb or less, although some companies include up to 45 lb in the category. Consumer and

MAJOR NORTH AMERICAN COATED FREE-SHEET PRODUCERS

(1991 estimated capacities, short tons)

		Annual capacity (000 tons)	Capacity share (%)
1.	Scott Paper[1,2]	1,100	26.2%
2.	Westvaco[2,3]	590	14.0
3.	Champion International	510	12.1
4.	Simpson Paper[2]	450	10.7
5.	Mead	382	9.1
6.	Potlatch	310	7.4
7.	Consolidated Papers[2]	300	7.1
8.	Repap Enterprises	220	5.2
9.	Noranda Forest	170	4.0
10.	Boise Cascade	100	2.4
11.	Abitibi-Price[4]	100	2.4
12.	Stora Papyrus Newton Falls	100	2.4

North American capacity (1991): 4,205 million tons
Canada: 182,000 tons
Capacity share of top five companies: 72.1%
Capacity share of top ten companies:[5] 98.3%

1. S.D. Warren Div.
2. *Pulp & Paper* estimate.
3. Some potential coated capacity is unused.
4. Provincial Papers currently has two machines operating.
5. Company capacities may not meet industry-wide estimates because of startup curves on new and rebuilt machines.

trade magazines and catalogs buy most of the LWC paper produced in North America; thus, LWC paper follows trends in magazines and catalog-related retail businesses. Companies tend to announce capacity additions when markets are good, but the capacity often comes online when the markets (or at least paper prices) are down, such as in 1986-87 and 1989-91. A variety of factors, including the economic recession of 1988-91, a move toward more targeted marketing, increased reliance on broadcast and cable television, and a proliferation of magazine titles that have to split the advertising pie, have given magazine publishers major nightmares that are unlikely to cease on a broad scale. Ad pages have generally declined for a number of years, including 1985, 1986, 1987, and 1990, and through the first nine months of 1991.

Coated groundwood as a percentage of total magazine tonnage has both declined and increased over the past few years even as the total amount of paper has continued to increase. In 1990 and 1991, about 81% of all paper consumed by domestic magazines was coated groundwood, rising to 82% in 1992, according to Magazine Publishers of America (MPA). Magazine publishers and printers purchased about 47% of the total coated groundwood paper produced in the U.S. in 1990. Magazine publishers are continuing the trend toward lighter basis weights at the low end and higher basis weights at the high end of the market.

MPA's *Paper Outlook* suggests publishers will continue to increase purchases of offshore paper, although an antidumping petition filed by U.S. mills against European producers could restrict some of those imports and turn business back to North American mills. Demand for non-North American coated groundwood represented 2.3% in 1990 and 2.6% in 1991 of the 1.103 million tons and 1.051 million tons, respectively, used by magazine publishers. The 1992 figure rises to 2.8%, barring the dumping issue. Uncoated SC groundwood paper, as a percent of total paper used, is as follows: 1990, 4.5%; 1991, 4.0%; and 1992, 3.6%. For other uncoated groundwood, the figures are 14.9% in 1990 and 1991 and 14.5% in 1992. Coated free-sheet represented 11.4% in 1990 and 12.3% in 1991 and will go to 11.8% in 1992. Uncoated free-sheet's portion is as follows: 1.6% in 1990 and 1.9% in 1991 and 1992.

Total paper tonnage used by magazines was expected to drop 4.1% to 1.587 million tons in 1991 compared with almost 1.656 million tons in 1990. The 1992 drop will be just 0.3%. Of major grades used by publishers, only coated free-sheet was expected to gain much market share in 1991, growing by 2.3%, but it will drop in 1992 by 3.4% to a level (158,000 tons) below that in 1990.

Magazine publishers as a rule are also reducing their longer-term inventories while increasing short-term supplies, made possible by relatively cheap pricing and easily accessible tonnage. For example, as of Mar. 31, 1991, 33.8% of publishers had one to 30 days of inventory on

NEW NORTH AMERICAN COATED PAPER CAPACITY THROUGH 1995

Company, U.S.	Location	Annual short tons	Grade	Startup
Blandin Paper	Grand Rapids, Minn.	221,000 net	CGW	1989
Potlatch	Cloquet, Minn.	No increase	CF	1989
Champion International	Bucksport, Maine	n.a.	CGW	1989
Wausau Paper Mills	Rhinelander, Wis.	25,000		1989
Champion International	Quinnesec, Mich.	265,000	CF	1990
Westvaco	Wickliffe, Ky.	100,000	CF	1990
S.D. Warren/Scott Paper	Muskegon, Mich.	45,000	CF	1990
S.D. Warren/Scott Paper	Skowhegan, Maine	215,000	CF	1990-91
Weyerhaeuser	Columbus, Miss.	n.a.		n.a.
International Paper	Various	200,000	CF	1988-92
Simpson	Pasadena, Texas	35,000	CF	1991
Consolidated Papers	Wisconsin Rapids, Wis.	212,000	CF	1991
Boise Cascade	Rumford, Maine	318,000	CGW	1993
James River	St. Francisville, La.	41	CGW	1993
Blandin Paper	Grand Rapids, Minn.	220,000	CGW	1993-94
G-P/Bowater	Millinocket, Maine	260,000	CGW	1993-94
Westvaco	Luke, Md., Wickliffe, Ky.	n.a.	CF	1994-95
Consolidated Papers	Wisconsin Rapids, Wis.	260,000	CGW	1994-95
James River	St. Francisville, La.	260,000	CGW	1994-95
Bowater	Calhoun, Tenn.	240,000	CGW	Postponed
Fraser	Madawaska, Maine	n.a.	CGW	Postponed
Mead	Escanaba, Mich.	n.a.	CF	Under study
Mead	Upper Peninsula, Mich.	n.a.	CF	Under study
Company, Canada	**Location**	**Annual metric tons**	**Grade**	**Startup**
Repap Enterprises	Newcastle, N.B.	200,000-260,000	CF/CGW	1989
Island Paper Mills	New Westminster, B.C.	75,000		1990
Malette/Rexfor	St-Raymond, Que.	70,000	MFC	1992
Orenda Forest	Terrace/Kitimat, B.C.	173,000	MFC	1993-94
Tembec	Temiscaming, Que.	200,000	CGW/MFC	1995
Repap Enterprises	Prince Rupert, B.C.	200,000		Under study

North American capacities, 1991
U.S.: 8.576 million short tpy
Canada: 702,000 metric tpy

n.a. = Not available.
CGW = Coated groundwood. CF = Coated free-sheet. MFC = Machine-finished coated.
Sources: *Pulp & Paper Week*, *Pulp & Paper Project Report*, Dean Witter Reynolds, American Paper Institute.

hand, compared with 23.2% as of Mar. 31, 1990, MPA reported. Meanwhile, 41.3% of publishers had inventories of 31 to 61 days, 13.8% had 61 to 90 days, and 8.8% had 90+ days in stock, compared with 42.7%, 19.5%, and 9.8%, respectively, in last year's survey.

U.S. PRICES FOR COATED PUBLICATION PAPERS

($/short ton)

Year	No. 1 70 lb, sheets	No. 3 60 lb, rolls	No. 4 50 lb, rolls	No. 5 34 lb roto, rolls –	No. 5 40 lb, rolls
1991					
3Q	$1,575-1,640	$1,070	$(855)/940	$(905)/990	$(780)/880
2Q	1,575-1,640	1,070	(855)/940	(905)/990	(780)/880
1Q	1,605-1,640	1,100	(885)/940	(935)/990	(810)/880
1990					
4Q	1,610-1,640	1,270*	(890)/940	(940)/990	(815)/880
3Q	1,610-1,640	1,270*	(890)/940	(940)/990	(815)/880
2Q	1,610-1,640	1,270*	(890)/940	(940)/990	(820)/880
1Q	1,610-1,640	1,270*	(900)/940	(960)/990	(850)/880
1989					
4Q	1,610-1,640	1,270*	(900)/940	(960)/990	(850)/880
3Q	1,610-1,640	1,270*	(900)/940	(960)/990	(850)/880
2Q	1,610-1,640	1,270	(920)/940	(950)/990	(840)/880
1Q	1,560-1,600	1,220	940-950	990-1,000	880-900
1988					
4Q	1,560-1,600	1,220	940-950	990-1,000	880-900
3Q	1,560-1,600	1,120	940-950	990-1,000	880-890
2Q	1,450	1,060	890	940	830/840
1Q	1,450	1,060	890	940	830
1987					
4Q	1,440-1,460	1060	840	890	790-800
3Q	(1,400)/1,415	1022	820	847	740
2Q	(1,390)/1,415	(945)/1,020	(740)/760	(760)/787	(640)/680
1Q	1,415*	(945)/1,020	(740)/760	(760)/787	(640)/680
1986					
4Q	1,375	980	760	860*	745
3Q	1,375	980	807	860*	(765)
2Q	1,375	980	880*	888*	798*
1Q	1,375	980	860*	902*	813*
Year end					
1985	1,375	980	880	931	842
1984	1,318	921	777	860	818
1983	1,250	830	661	782	n.a.
1982	1,200	798	690	760	n.a.
1981	1,130	798	n.a.	760	n.a.
1980	1,038	750	n.a.	735	n.a.
1979	970	690	n.a.	671	n.a.
1978	893	621	n.a.	573/590	n.a.
1977	n.a.	600	n.a.	520/545	n.a.
1976	n.a.	540	n.a.	460	n.a.
1975	n.a.	486	n.a.	399	n.a.
1974	n.a.	475	n.a.	400	n.a.
1973	n.a.	n.a.	n.a.	285	n.a.

*Discounting off list price reported.
( ) = Average transaction price.
n.a. = Not available.
Sources: *Pulp & Paper Week, Pulp & Paper Pricebook2.*

MPA also measured the shift in basis weight demand. There were major shifts to lighter basis weights in 1991 due in part to the postal rate increase in February and also because on a square footage basis, lighter-weight paper is less expensive. The shift was primarily from 34 lb to 32 lb by the major newsweeklies. More specifically, in 1990, 9.9% of publishers surveyed used 32-lb paper. In 1991, that figure jumped to 16.8%, MPA said. And 1992 will see virtually no change. Among, the magazines that have switched from 34 lb to 32 lb are *Time* and *Newsweek*. Two heavier basis weights, 45 lb and 60 lb and above, are expected to gain a small percentage of market share.

Along with shifts in paper grades and basis weights, publishers continue to shift slightly in printing technologies. However, these shifts tend to go back and forth. In 1990, 78.9% of publishers used the offset process, while 21.1% used gravure. In 1991, offset rose to 79.4% and gravure fell to 20.6%, but those figures reverse again in 1992, with offset being used by 78.9% and gravure by 21.1% of publishers surveyed.

Major retailers, such as Wal-Mart, K-Mart, Sears Roebuck & Co., and Macy's, have used rotonews and SC papers more liberally in their catalogs and advertising, although for magazines SC is still considered less desirable. Still others have moved from coated groundwoods to No. 4 coated free-sheet grades as a result of those prices weakening in 1987 and 1989-91 and also to enhance their image.

As mechanical integrity of the sheet has become more important, new papermaking technologies have developed. These technologies enhance runability and printing characteristics such as ink holdout and ink gloss, which are more important to publishers than opacity.

And with the drop in basis

weights below 36 lb, mills must reduce the weight of both the basestock and the coating. Different coating mixtures and new lightweight chemical compositions allow some mills to make reductions in coat weight—going to a 6-lb coating formulation, for example, from a 10-lb or higher formulation. Other mills reduce the weight of the basestock by a greater percentage. Some mills can use a lighter-weight basesheet than other mills. Surface smoothness is the deciding factor.

COST FACTORS

The decision of whether to make coated free-sheet, coated groundwood, or a blended sheet is predicated upon such issues as production cost and user needs, including, but not limited to, changes in printing technologies. Mills can add kraft fiber for strength, helping to reduce breaks in web printing. Adding groundwood fiber reduces cost, maintains opacity and surface smoothness, and supplies much of the sheet's fiber content.

TMP and CTMP provide an intermediate range of characteristics. The TMP process produces fibers that are better separated than stone groundwood pulp fibers and that have the added benefit of retaining much of their original length. Thus, TMP fibers hold together better, adding strength to the finished paper. CTMP has a tensile strength about equal to chemimechanical pulp and higher than TMP as well as a higher tear factor (important in high-speed printing applications). CTMP paper normally has a lighter color than TMP.

Mills such as International Paper's coated groundwood mill at Pine Bluff, Ark., use a variation of CTMP called chemically enhanced groundwood for their basesheet. As mentioned previously, Tembec may install a coated groundwood or MF coated machine at its Temiscaming CTMP mill.

Use of recycled fibers for coated groundwood papers is still limited, although several mills—such as Champion, Repap, Simpson Paper Co., and Niagara of Wisconsin Paper Corp.—have introduced some recycled grades. With recycled uncoated free-sheet papers already on the market, it was easier for coated free-sheet mills (some mills make both uncoated and coated) to bring out recycled grades. Among these producers are Scott, Champion, Potlatch Corp., Putney Paper Co. Inc., Stora Papyrus Newton Falls, Simpson, and Westvaco.

Titanium dioxide is the preferable coating material, especially for LWC, because of its superior opacity. But TiO_2 pricing is volatile and is generally higher than alternatives. Kaolin clays remain the most widely used coating by volume—about 3 million tons used in 1990 compared with 135,000 tons of TiO_2. When TiO_2 is used, such as with delaminated grades, the balance of coating material content is specialized clay: calcium carbonate, hydrated alumina, plastic pigment, talc, and zinc oxide.

OUTLOOK FOR COATED PAPERS

Growth in demand for Nos. 1, 2, and 3 grades, along with C1S papers, is expected to average 5%/year or less in 1991-2000. C1S is forecast to increase just 2.3% annually,

COATED PAPER SHIPMENTS TO MAGAZINE PUBLISHERS

(000 short tons)

Year	Coated two side paper Total Coated[1]	Nos. 1-4	No. 5	All grades[2]	Coated imports[3]
1990	2,335	680	1,655	2,483	936
1989	2,436	899	1,537	2,436	774
1988	2,510	926	1,584	2,510	798
1987	2,420	622	1,798	2,903	675
1986	2,428	527	1,901	2,432	501
1985	2,275	448	1,827	2,299	496
1984	2,397	498	1,899	2,428	428
1983	2,290	470	1,820	2,450	162
1982	2,010	425	1,585	2,130	69
1981	2,009	408	1,601	2,185	36
1980	1,969	405	1,564	2,125	115
1979	1,838	400	1,438	2,017	189
1978	1,902	365	1,537	2,054	214

1. Includes coated one side. Essentially no C1S shipped in 1988 and1989.
2. Includes uncoated groundwood and uncoated free-sheet grades.
3. Includes nonmagazine shipments.
Source: *Pulp & Paper* estimates.

PAPER SHIPMENTS TO COMMERCIAL PRINTERS

(000 short tons)

	Coated two side paper					
Year	Total	Nos. 1-4	No. 5	Uncoated free-sheet	Uncoated groundwood	Total
1990	3,888	2,069	1,819	2,778	1,120	7,786
1989	3,044	2,283	761	2,800	381	6,225
1988	3,009	2,256	753	2,857	306	6,172
1987	2,842	2,140	702	2,735	177	5,754
1986	2,469	1,900	569	2,570	202	5,241
1985	2,240	1,760	480	2,430	250	4,920
1984	2,400	1,830	570	2,350	280	5,030
1983	2,075	1,535	540	2,165	245	4,485
1981	1,720	1,300	420	1,950	175	3,845
1980	1,605	1,200	405	2,000	220	3,825

Source: *Pulp & Paper* estimates.

while No. 1, which posted double-digit growth from 1973-90, will drop to 5.0%. No. 2, which hovered at 9.5%/year in the 1973-90 period, will slow to 4.3%. And No. 3, which had already seen some slowing in demand growth, will fall to increases of 3.9%/year, similar to levels for Nos. 4 and 5. No. 4, including both groundwood and free-sheet grades, will average 3.7% annual growth in the current decade after growth of more than 7%/year over the last two decades. Growth in No. 5 groundwood papers will run about 3.9%/year.

The relatively stronger demand for No. 1 papers is supported by demand for high-quality printing, such as annual reports and advertising brochures, and by a general shift up from No. 2 grades.

Primary markets for No. 2 grades will remain automobile brochures and brochures for other upscale merchandise. No. 3 papers have a wider range of uses, and recent expansions make the paper readily available; some customers may upgrade from No. 4 papers if the price is right. Demand for No. 4 free-sheet will increase faster than demand for No. 4 groundwood, but both will continue to compete with No. 5 groundwood and SC papers. No. 5, which is getting competition from all sides (both MF coated and SC uncoated), has been hurt by the decline in magazine advertising and the cautious tactics from catalog publishers. But this relatively slow growth still translates into major tonnage increases.

After strong pricing in 1987-88, the economic recession and other factors combined to drive down coated paper prices in 1989-91. By the end of third-quarter 1991, prices were as follows: No. 1, 70 lb, in sheets, transaction prices of $1,575, off 2.2% from a year earlier; No. 3, 60 lb, in rolls, transaction prices of $1,070, down 15.7%; No. 4, groundwood, 50 lb, in rolls, $855, off 3.9% from 1990; No. 5, 34 lb rotogravure, in rolls, $905, 3.7% lower than a year earlier. Pricing levels for No. 1 are expected to increase 55% in the 1991-2000 decade, while No. 3 grades will rise about 60% and No. 5 about 71% based on a constant inflationary increase combined with market demand.

EUROPEAN CAPACITY

North American producers continue to face stiff competition from European mills because of excess capacity there. The European Paper Institute's annual survey, which uses capacity figures for projects already under construction (leaving out capacity planned but not yet under con-

U.S. ADVERTISING VOLUME

(million $)

Medium	1988	1989	Change (%)
Newspapers	$32,368	$32,281	-0.3%
Magazines	6,716	6,803	1.3
Farm publications	212	215	1.4
Television	26,891	28,405	5.6
Radio	8,323	8,726	4.8
Yellow Pages	8,330	8,926	7.2
Direct mail	21,945	23,370	6.5
Business papers	2,763	2,875	4.1
Outdoor	1,111	1,084	-2.4
Miscellaneous	15,271	15,955	4.5
Total	123,930	128,640	3.8

Source: Prepared for *Advertising Age* by Robert J. Coen, McCann-Erickson.

TRENDS IN PAPER USE BY MAGAZINE PUBLISHERS

(000 short tons)

	1990	1991e	1992e
Coated groundwood[1]	1,153	1,139	1,183
Coated groundwood[1]	1,103	1,051	1,057
Coated free-sheet[1]	160	164	158
Uncoated groundwood[1]	210	195	193
Supercalendered[1,2]	47	45	42
Uncoated free-sheet[1]	23	25	25
Supercalendered "free-sheet"	63	64	64
Imported coated groundwood	33	35	37
Imported uncoated groundwood	0.4	0.3	0.3
Imported supercalendered[2]	13	8	7
Imported coated free-sheet	2	0	0
Total[3]	1,406	1,335	1,335

e = Estimate.

1. North American sources.

2. Not included in uncoated groundwood category.

3. May not total due to rounding.

Source: 1991 Magazine Publishers of America, *The Paper Outlook*.

TRENDS IN MAGAZINE-GRADE PAPER BASIS WEIGHTS

(% of total tons used)

Basis weight	1990	1991e	1992e
Under 32 lb	2.6%	2.5%	2.5%
32 lb	9.9	16.8	16.6
33 lb			
34 lb	22.0	18.8	19.6
35 lb			
36 lb	14.2	11.8	11.0
38 lb	3.9	4.7	4.5
40 lb	20.9	18.7	18.0
45 lb	6.8	7.8	7.8
50 lb	7.6	6.9	5.9
55 lb	0.6	0.6	0.5
60 lb and above	11.5	11.7	13.9

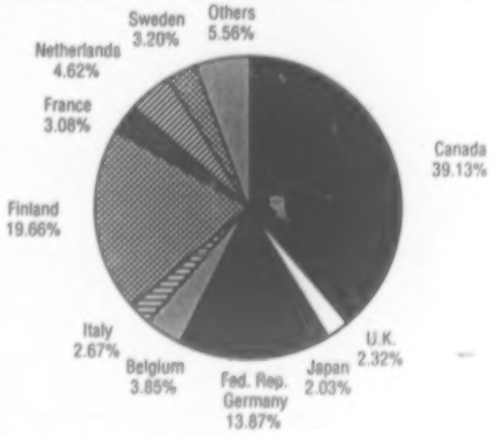
e = Estimate.

Source: 1991 Magazine Publishers of America, *The Paper Outlook*.

struction), said that SC magazine paper will surpass coated grades as the growth leader of the three major sectors, with capacity expected to rise 28.3% from 1991 through 1995, an increase of 887,000 metric tons over the period. SC capacity will reach 4.021 million tons by 1995, EPI reported. However, deliveries are predicted to advance less than 3%/year, representing just 80% of capacity—3.129 million tons—in 1995, the EPI survey said.

Capacity for coated papers is projected at 6.398 million tons in 1995, an 11.6% increase over those five years. Deliveries for rolls of coated mechanical papers are forecast to rise 5%/year to 5.452 million tons, or about 85% of capacity. Still, demand is expected to be high enough to substantially absorb the new capacity. Demand for coated papers is affected positively by strong trends toward color print advertising, but the recession and lower economic growth in most major economies adversely affect print advertising as consumers and businesses decrease spending.

U.S. COATED PAPER IMPORTS, 1990



Total 1990 coated paper imports: 964,340 tons
Source: Dept. of Commerce.

U.S. COATED PAPER EXPORT/IMPORT BALANCE

(000 short tons)

Year	Exports[1]	Imports[2]
1991e	235	938
1990p	219	936
1989	169	774
1988	97	798
1987	101	675
1986	78	501
1985	82	496
1984	86	428
1983	79	162
1982	81	69
1981	89	39
1980	92	115
1979	74	189
1978	74	214
1977	99	113[3]
1976	107	—
1975	123	—
1974	99	—
1973	80	—
1972	76	—
1971	76	—
1970	75	—
1969	70	—

e = Estimate.
p = Preliminary.
1. Clay-coated printing/writing paper.
2. Coated and impregnated printing papers.
3. In previous years, coated paper imports were reported under another category.
Source: Bureau of the Census.

Paper:

UNCOATED FREE-SHEET

North America's uncoated free-sheet (or white papers) business (as with the industry as a whole) has undergone substantial structural change at all levels, including mills, distribution channels, and end users, according to W. Craig McClelland, president and chief operation officer of Union Camp Corp. "Compared to ten years ago," McClelland says, "the paper industry is producing more product... with 12,000 fewer employees. Today, ten producers have almost 60% of the [white papers] capacity." In addition, he says, "over the past decade, over 60% of the printing/writing capacity has been newly installed or rebuilt."

NORTH AMERICAN STATISTICS FOR UNCOATED PRINTING/WRITING PAPERS*

	1991e	1990	1989r	1988	1987	1986
U.S.						
Production,[1] 000 tons	11,844	11,510	11,081	11,277	10,977	10,410
Capacity, 000 tons	12,717	12,145	12,092	11,853	11,493	11,023
Utilization rate	93.1%	94.8%	91.6%	95.1%	95.5%	94.4%
Imports, 000 tons	754	743	583	592	417	454
Exports, 000 tons	252	233	122	83	68	50
Apparent U.S. consumption						
000 tons	12,346	12,020	11,542	11,786	11,326	10,814
lb/capita[r]	97.79	96.17	93.33	95.54	93.19	89.80
000 tons/billion $ real GNP (1982)	2.86	2.90	2.78	2.93	2.94	2.91
Canada						
Production,[2] 000 tons	1,387	1,359	1,155	1,023	—	—
Capacity,[2] 000 tons	1,651	1,574	1,451	1,153	—	—
Utilization rate	84.0%	86.3%	79.6%	88.7%	—	—
Exports, 000 tons	682	662	465	284	—	—
Apparent consumption	705	607	690	728	—	—

*All tons are short tons.
e = Estimate.
r = Revised.
1. American Paper Institute data for shipments.
2. Canadian Pulp & Paper Assn.
Source: *Pulp & Paper.*

And at almost 13 million tons of capacity in 1991, uncoated free-sheet papers (also called uncoated woodfree as well as white papers or business papers) account for by far the largest segment of U.S. capacity for printing/writing grades (the others being uncoated groundwood and coated papers). Uncoated woodfree papers are made for a wide variety of end uses, such as reprographic and other business papers, personal and business stationery and envelopes, carbonless basestock for business forms, book paper, basestock for thermal paper, and commercial printing for direct mail. Canada also has substantially increased its presence in uncoated woodfrees, bringing 1991 capacity to almost 1.8 million short tons.

Mills use mostly chemical pulps (sulfate, sulfite, soda, cotton linters, or vegetable fiber) to produce uncoated papers. The following are some exceptions:

- Cotton-content paper, related to uncoated free-sheet but discussed in a separate chapter

- Mechanical pulp added to the fiber mix (to be called free-sheet it must contain less than 10% mechanical), with some mills introducing furnishes such as bleached chemithermomechanical pulp (BCTMP), which can be combined with kraft pulp to reduce the cost of manufacture while providing a better grade of paper than stone groundwood or other mechanical pulps
- Recycled fibers, primarily from postindustrial (that is, papermaking and converting operations), and some postcommercial (printer waste) and postconsumer waste (collection of office and residential papers), some of which is also deinked.

When arranged by end uses, uncoated free-sheet papers are generally spread into four subgroupings: publishing, commercial printing, office/business, and writing. A smaller subgrouping includes products such as cigarette papers and carbonizing tissue.

Bond and copy papers currently represent the largest single segment of uncoated free-sheet—about 27% of total 1990 production. Offset, once the largest sector, has dropped to about 24% of total 1990 production. Offset has fallen as reprographic paper is used more and more in such applications as computer page (laser) printers, copiers, and other office technologies. Forms bond represented about 18% of 1990 production, with its sister paper, carbonless basestock, at 6.6%. Envelope papers were just over 11%. Tablet papers, a lesser relative of forms bond, and the combined text and cover segments each accounted for almost 4%, with the balance composed of miscellaneous printing/writing papers.

The U.S. South has increasingly become the site of substantial growth in uncoated woodfree capacity, but there also is growth in the Midwest. Historically, U.S. production of uncoated free-sheet primarily has been concentrated in the Northeast and upper Midwest. Again, capacity has also increased in Canada, where four new uncoated free-sheet machines have come online since 1987.

U.S. capacity growth of uncoated free-sheet paper (including cotton and thin) is estimated by the American Paper Institute to grow regionally in the 1989-93 period as follows: New England, 0.3%; Mid-Atlantic, a loss of 0.5%; East North Central (Midwest), a loss of 1.1%; South Atlantic, 30.3%; East South Central, a loss of 0.7%; West South Central, 24.2%; and Mountain and Pacific, 1.9%. About 512,000 tpy of capacity in 1993 will be represented by the seven states bounded on the north by North Dakota and Minnesota and on the south by Kansas and Missouri.

As percentages of total uncoated woodfree capacity by the end of 1993, the Midwest (East North Central) will account for almost 18%, the South Atlantic region nearly 19%, New England just under 10%, Mid-Atlantic states less than 13%, West South Central up to almost 15%, East South Central under 13%, West North Central less than 4%, and Mountain and Pacific 10.5%, according to API.

New capacity onstream by the end of 1991 included Georgia-Pacific Corp.'s 325,000-tpy machine at Ashdown, Ark., Boise Cascade Corp.'s 300,000-tpy machine at International Falls, Minn. (late 1990), Willamette Industries

UNCOATED FREE-SHEET PAPERS CLASSIFIED BY END USE

Printing/publication
- Offset (book)[1]
- Lightweight printing[1]
- Envelope[1]
- Tablet[1]
- Cover and text[1]

Writing
- Bond
- Cotton fiber[2]

Bristols[2]

Business
- Forms bond[1]
- Copy and reprographic[1]
- Carbonless[1]
- Mimeograph[1]
- Duplicating[1]
- Other

Thin papers
- Carbonizing
- Cigarette
- Condenser

1. Conforms to American Paper Institute classification of free-sheet.
2. This grade discussed in separate section.

U.S. PRODUCTION AND CAPACITY OF UNCOATED FREE-SHEET PAPERS*

(000 short tons)

Year	Production[1]	Change (%)	Capacity[2]	Change (%)
1991e	11,844	2.9%	12,717	4.7%
1990r	11,510	3.9	12,145	2.7
1989r	11,081	-1.7	12,092	2.0
1988	11,277	2.7	11,853	3.1
1987	10,977	5.4	11,493	4.3
1986	10,410	7.4	11,023	4.8
1985	9,690	5.9	10,515	4.5
1984	9,152	4.9	10,058	7.5
1983	8,725	11.7	9,354	3.5
1982	7,809	-0.1	9,039	2.4
1981	7,867	-0.1	8,828	2.1
1980	7,984	4.6	8,645	6.8
1979	7,655	6.3	8,095	3.1
1978	7,198	2.3	7,847	5.1
1977	7,036	9.4	7,465	2.0
1976	6,430	13.9	7,319	1.9
1975	5,644	-18.6	7,180	1.9
1974	6,934	0.0	7,046	7.7
1973	6,933	9.4	6,541	5.5
1972	6,339	18.5	6,198	7.2
1971	5,349	3.3	5,780	1.3
1970	5,177	-0.8	5,702	0.3
1969	5,222	—	5,681	—
Average 1970-90		4.2		3.8

*Excluding cotton-fiber, bristol, and thin paper.
e = Estimate.
r = Revised.
1. Source: Bureau of the Census, American Paper Institute.
2. Source: American Paper Institute.

Inc.'s 255,000-tpy machine at Bennettsville, S.C. (September 1990), and Union Camp's 240,000-tpy machine at Eastover, S.C. (1991). Federal Paper Board Co. Inc. was considering its first uncoated free-sheet printing/writing paper machine for Augusta, Ga., rather than a previously planned bleached paperboard machine, but it has put those plans on hold. The two grades are similar, and Federal already makes printing bristols.

As the machines at Boise and Georgia-Pacific indicate, U.S. mills have moved to larger, commodity-oriented uncoated free-sheet paper machines that are more economical to run (but sometimes have negative market consequences if too much capacity comes online, as in the 1990-91 period, which also coincided with the economic recession). In 1989, 421 machines were in place that produced printing/writing papers (including uncoated groundwood and coated papers). The number of machines producing over 125,000 tpy rose from 7.5% of total industry capacity in 1975 to 34% in 1987 and 38% in 1989. Units of 75,000 tpy and below fell from 72.5% of industry capacity in 1975 to 43% in 1987 and 40% in 1989.

Commodity-grade mills (offset paper, forms bond, and reprographic paper) use twin-wire or large fourdrinier paper machines. Southern mills use a blend of hardwood and softwood pulps. Hardwood fibers provide desired bulk and printing characteristics, and softwood fibers offer strength properties for improved paper machine and printing press runability.

It would be expensive for mills with these larger machines to purchase most of their pulp, so mills that get major paper capacity additions also usually undergo expansion of pulpmaking capacity. Sometimes that pulpmaking expansion leads to excess capacity, allowing the mill to transfer or sell pulp to other units of the same company or sell it to other companies (see Market Pulp chapter).

As mentioned previously, many printing/writing mills are using increasingly larger amounts of various types of wastepaper. But both integrated and nonintegrated often have to rely on outside sources for recycled and/or deinked pulp as demand for recycled papers grows, spurred by private business/consumer demand and government mandate.

Nonintegrated mills, that is, those that do not produce their own pulp and are usually the older, smaller mills in the Northeast, are subject to the vagaries of the pulp market. When pulp prices are low, they can produce paper more cheaply. But when pulp prices are high, these mills can have trouble competing with the newer, larger, commodity paper mills and must try to define new markets in higher-value products, modernize the equipment, or face financial disaster.

The cost of pulp represented only 33.9% of selling price in 1970, whereas in 1980 it rose to 56.0% in the U.S. The

CAPACITIES OF NORTH AMERICAN UNCOATED FREE-SHEET PRODUCERS, 1991

		Annual capacity (000 short tpy)	Market share (%)
1.	International Paper	2,110	14.7%
2.	Georgia-Pacific	2,100	14.6
3.	Champion International[2]	1,226	8.5
4.	Boise Cascade	1,205	8.4
5.	Union Camp[3]	900	6.3
6.	Weyerhaeuser[4]	765	5.3
7.	James River	730	5.1
8.	Domtar	650	4.5
9.	Mead[5]	520	3.6
10.	Willamette	479	3.3
11.	Simpson Paper(e)	475	3.3
12.	P.H. Glatfelter.	420	2.9
13.	CP Forest	314	2.2
14.	Noranda Forest	295	2.1
15.	Scott Paper	240	1.7
16.	Westvaco(e)[6]	200	1.4
17.	Rolland	165	1.1
18.	Eddy Paper	160	1.1
19.	Federal Paper Board[7]	138	1.0
20.	Island Paper Mills[8]	105	0.7
21.	Fraser[8]	88	0.6

Market share of top five companies: 62.9%
Market share of top ten companies: 77.7%
Total North American capacity/year (1991):[10]
14,368 million short tons
U.S.: 12.717 million short tons
Canada (e): 1.651 million short tons

e = *Pulp & Paper* estimate.
1. New 320,000-tpy machine at Ashdown, Ark., started up May 1991.
2. Year-end 1990 capacity.
3. New 250,000-tpy machine started up mid-1991.
4. Includes Prince Albert, Sask.
5. Includes carbonless basestock.
6. Includes swing tonnage for coated production.
7. May build new 800-tpd machine at Augusta, Ga.
8. Owned 50% by MacMillan Bloedel Ltd. and 50% by Fraser Inc.
9. Owned by Noranda Forest Inc.
10. Includes all other companies.

RISE OF ROLLSTOCK vs SHEET-FED PAPER IN U.S. UNCOATED OFFSET FREE-SHEET PAPER INDUSTRY

(% of total uncoated free-sheet shipments)

Year	Rolls	Sheets
1995	74%	26%
1990	70	30
1988	68	32
1984	66	34
1980	61	39
1975	53	47
1970	45	55
1965	35	65

Source: *Pulp & Paper* estimates.

situation improved in early 1982, when hardwood pulp was available at deep discounts and the list price for pulp was unchanged from 18 months earlier. Pulp represented 49.7% of the paper grade's selling price, assuming no pulp discount. The percentage was lower if discounts were applied. The pulp cost advantage of an integrated mill—$100 in 1980—probably declined as the pulp market slid. In mid-1984, pulp prices began rising again, and uncoated free-sheet was plagued by continued discounting, especially in offset grades. The cost of pulp climbed back up to 53.5% of the paper grade's selling price. The ratio of selling prices dropped back down in 1985, began another climb following strong pulp price increases in late 1986, 1987, 1988, and 1989, and then dropped again in 1990-91 as world pulp prices declined. Unfortunately for all mills, but especially the nonintegrated producers, paper prices declined further and faster than savings in pulp costs.

Nonintegrated mills also usually have higher fuel costs because they do not generate wastewood to supply biomass boilers or produce byproduct fuel from kraft liquor. Their biggest advantage is lower transportation costs because of their proximity to major markets in the North.

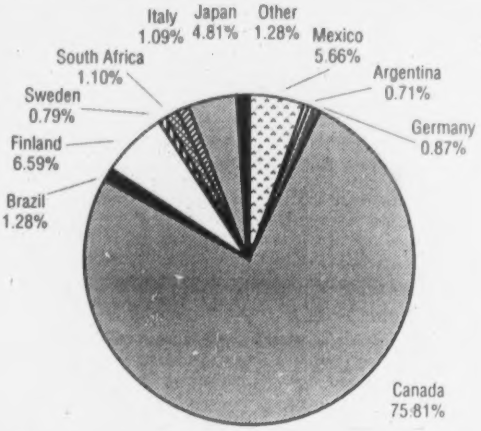
Uncoated free-sheet papers have seen continuous growth for more than a decade. Shipments leaped 11.7% in 1983, after 0.1% drops in both 1982 and 1981, according to API figures. Shipments rose 4.9% in 1984, 5.9% in 1985, 7.4% in 1986, 5.5% in 1987, and 3.2% in 1988. They had a slight 2.1% decline in 1989, however, due in part to high customer inventories and other factors. In 1990, U.S. producers gained 3.9% in shipments.

Operating rates remained fairly strong despite some slackening in 1989. But by mid-1990, rebuilding of inventories and generally strong demand was boosting shipments above year-earlier levels. A recession in 1991 or 1992, along with the addition of almost 1 million tons of capacity in 1990-91, dampened operating rates to the low 90% range. A number of mills took extended maintenance downtime in 1990 and 1991 because of slower demand and overcapacity brought on by the addition of 1 million tons. In the early 1980s, mills operated at rates below 90%. In 1981, the operating rate for uncoated free-sheet mills was 89.1%, falling to 86.4% in 1982. The market began to strengthen, and operating rates rose to 93.3% in 1983, 91.0% in 1984, 92.2% in 1985, 94.4% in 1986, 95% in both 1987 and 1988, and 91% in 1989. Utilization rates were over 94% in 1990 but dropped down to about 91% in 1991.

The overcapacity situation, along with the recession, caused a collapse in pricing for white papers in the 1990-91 period. This fall came after relatively steady price advances since 1986. However, by late 1989, discounts on offset grades were as high as $60 to over $100/ton and eventually came close to $200/ton, while prices for cut-size copy papers were off about the same levels. Canada's Free Trade Agreement with the U.S. eliminated cross-border tariffs on business forms in 20% increments over a five-year period that began on Jan. 1, 1989. Also affecting pricing was relatively cheap and readily available paper from offshore.

Customers in the U.S. have continually increased their purchases from offshore mills, forcing imports of uncoated

U.S. UNCOATED FREE-SHEET IMPORTS, 1990



Total uncoated free-sheet imports: 759,332 tons.

Source: Dept. of Commerce.

FIBER COSTS FOR PRODUCING PRINTING GRADES AT NONINTEGRATED PAPER MILLS

Year	45-lb No. 3 offset sheets ($/short ton)	Northern hardwood kraft market pulp ($/short ton)	Ratio of selling prices (pulp/paper)
1990	$940	$570	0.606
1989	940	745	0.793
1988	1,020	705	0.691
1987	850	522	0.614
1986	850	426	0.501
1985	800	327	0.409
1984	880	426	0.484
1983	840	381	0.454
1982	680	345	0.507
1981	878	445	0.507
1980	813	445	0.547
1979	717	393	0.548
1978	645	310	0.481
1977	555	250	0.450
1976	506	300	0.593
1975	484	335	0.692
1974	535	335	0.626
1973	457	225	0.492
1972	460	135	0.293
1971	455	135	0.297
1970	442	155	0.351

Note: All prices are year-end.
Source: *Pulp & Paper Week; Pulp & Paper Pricebook 2.*

U.S. PRICES FOR UNCOATED WHITE PAPER

($/short ton)

Year	Offset 50-lb rolls	Bookpaper No. 3 offset +45-lb sheets	Bond, No. 4 unwatermarked 20 to 24-lb sheets	No. 1 watermarked +20-lb sheets	Forms bond 15-lb rolls	Bond 25% cotton sheets	Carbonless coated-back 15-lb rolls
1991							
3Q	$(640)/860	$(860)	$(680)	$1,080	$(640)/930	$2,420	$2,040
2Q	(640)/860	(860)	(680)	1,080	(640)/930	2,420	1,900
1Q	(750)/860	(940)	(860)	1,090	(700)/930	2,440	2,000
1990							
4Q	(840)/860	(940)	(920)	1,090	(890)/930	2,440	2,000
3Q	(800-840)	(940)	(880)	1,090	(890)/930	2,440	2,000
2Q	810	940	980	1,095	840	2,200	1,960
1Q	810	940	975	1,095	830	2,200	1,960
1989							
4Q	790	940	975	1,095	830	2,200	1,920
3Q	810	940	980	1,095	840	2,200	1,920
2Q	900	1,020	1,020-1,040	1,090-1,100	(880)	2,200	1,960
1Q	900	1,020	1,040	1,090-1,100	(880)	2,200	1,960
1988							
4Q	880-900	1,020	960	1,090	910	2,200	1,960
3Q	840-850	960	920	1,080	850/870	2,200	1,904
2Q	810	920	880	1,070	850/870	2,125	1,904
1Q	770	870	840	1,030	800	2,125	1,778
1987							
4Q	750	850	820	980	760	1,990/2,060	1,778
3Q	750	820	727-747	(920)/985	760	1,900	(1,660)
2Q	(640)	820	760	(930)/985	720*	1,810	(1,625)
1Q	(640)	820	(720)/820	(930)/985	720*	1,810	(1,625)
1986							
4Q	700	850	820*	985*	720	1,810	1,710
3Q	706	850	807	985	687	1,810	1,710
2Q	(663)	(840)	(760)	985	(660)	1,810	1,593
1Q	(597)	(800)	(760)	985	(620)	1,810	1,458
Year end							
1985	(567)	(800)	(760)	985	(600)	1,810	1,355
1984	(600)	(880)	(773)	985	(693)	1,810	1,355
1983	690	840	810	960	745	1,650/1,730	n.a.
1982	(540)	680	640	916	640	1,650	n.a.
1981	690	878	867	916	753	1,650	n.a.
1980	n.a.	813	803	848	697	1,490	n.a.
1979	n.a.	711/717	720	778	620	1,309/1,343	n.a.
1978	n.a.	645	640/644	695	538/550	1,190/1,230	n.a.
1977	n.a.	548/555	548/590	645/650	450/500	1,143	n.a.
1976	n.a.	506	561	628	519/520	1,083	n.a.
1975	n.a.	484	550	605	495/504	1,012	n.a.
1974	n.a.	535	559	637	470	984	n.a.
1973	n.a.	457	495	n.a.	n.a.	734	n.a.
1972	n.a.	460	470	n.a.	n.a.	728	n.a.
1971	n.a.	455	460	n.a.	n.a.	719	n.a.
1970	n.a.	442	445	n.a.	n.a.	n.a.	n.a.
1970	n.a.	442	445	n.a.	n.a.	n.a.	n.a.

*Discounting from list prices reported.
( ) = Indicates estimated transaction prices where most volume is moving significantly below list.
n.a. = Not available.
Sources: *Pulp & Paper Pricebook; Pulp & Paper Week.*

free-sheet up 25% from 1988 to 1990. That increase, from 592,000 tons to 743,000 tons, came mostly from Europe, although mills in South America also made headway, as did Canada, which became the major source, shipping over 603,000 short tons of uncoated free-sheet papers to the U.S. in 1990, according to the Canadian Pulp & Paper Assn.

NORTH AMERICAN CUT-SHEET SUPPLY

(000 short tons)

End use	1989	1994	Compound annual growth rate
U.S.			
Printers	842	1,759	16%
Copiers	1,854	2,299	4
Typewriters	134	80	-10
Duplicators	361	185	-12
Total	**3,191**	**4,323**	**6**
CANADA			
Printers	72	149	16
Copiers	128	169	6
Typewriters	12	7	-12
Duplicators	29	15	-12
Total	**241**	**339**	**7**

Source: BIS Strategic Decisions.

(576,000 tons according to the U.S. Dept. of Commerce), an increase of almost 46% from 1989, which itself saw a 63% increase from the year before. These increases were due primarily to new capacity at Domtar Inc.'s Windsor, Que., mill and at Canadian Pacific Forest Products Ltd.'s Dryden, Ont., mill.

Finland and Sweden combined shipped 56,000 tons, a drop of 33% from 1989. Brazil started to regain some market share after duties imposed earlier were taken off. Those 100% duties cut Brazilian shipments to only 1,850 tons in 1989, a decline of almost 98%, but Brazil shipped almost 10,000 tons in 1990. Two new machines started up in 1991 are expected to have a major impact on imports. Mexico also started up a new machine in 1991, which is largely targeted at the U.S. Mexico shipped 43,000 tons of uncoated free-sheet in 1990, a slight drop from 1989, which itself saw deliveries decline 41% from the previous year.

GENERAL INDUSTRY TRENDS

ALKALINE PAPERS

By about mid-1991, close to 80 printing/writing paper mills in the U.S. and Canada, mostly uncoated, had partially or completely converted to alkaline papermaking (see table Alkaline Printing/Writing Mills). Another 21 mills were planning or in the process of conversion. Many new machines or mills are planned ahead as alkaline-based systems.

Mills have converted to alkaline papers for two primary reasons. First, producing alkaline papers is actually cheaper than producing acid-based papers because the alkaline process helps control costs for fiber and fillers, such as titanium dioxide (TiO_2) and calcine clay. Alkaline sheets are also stronger than acid-based papers, and the use of precipitated calcium carbonate (PCC) helps cut down fiber use. Second, librarians, government, and businesses are concerned with archival-quality documents, and permanence is a distinct advantage of alkaline papers over acid-based stocks. The American Library Assn. Council and the National Information Standards Organization have been urging publishers to print books with alkaline-based papers. Major and minor volumes in both public and private collections (especially the Library of Congress) are deteriorating, sometimes before they can be saved by preservation technology or copied onto other media, such as microfilm.

NEW U.S. AND CANADIAN UNCOATED FREE-SHEET CAPACITY THROUGH 1993

Company, U.S.	Location	Annual capacity (short tons)	Year
Willamette	Bennettsville, S.C.	255,000	1990
Champion International[1]	Quinnesec, Mich.	(net) 58,000	1990-91
Georgia-Pacific/Nekoosa	Ashdown, Ark.	80,000	1990
Union Camp	Eastover, S.C.	50,000	1990
Boise Cascade	International Falls, Minn.	308,000	1990
Georgia-Pacific/Nekoosa	Ashdown, Ark.	325,000	1991
Union Camp	Eastover, S.C.	240,000	1991
Champion International	Courtland, Ala.	240,000	1993
Company, Canada	**Location**	**(metric tons)**	**Year**
Weyerhaeuser Canada	Prince Albert, Sask.	217,000	1988
Domtar	Windsor, Que.	160,000	1989
Canadian Pacific Forest Products	Dryden, Ont.	175,000	1989

North American capacities, 1991
U.S.: 12.717 million short tpy
Canada: 1.777 million short tpy

1. Initially will produce uncoated free-sheet but is designed for coated.
Sources: *Pulp & Paper Week* estimates, American Paper Institute, Canadian Pulp & Paper Assn.

Pfizer is the primary suppli-

ALKALINE PRINTING/WRITING PAPER MILLS

Company	Mill	Capacity (tpd)	Notes
Appleton Papers	Combined Locks, Wis.	530	
	Roaring Spring, Pa.	210	
	West Carrollton, Ohio	350	
Beckett	Hamilton, Ohio	160	
Boise Cascade	Jackson, Ala.	240	
	Rumford, Maine	1,475	White papers portion only
	International Falls, Minn.	1,450	
	St. Helens, Ore.	700	
	Vancouver, Wash.	290	
	Wallula, Wash.	590	
Canadian Pacific Forest Products	Dryden, Ont.	880	
Champion International	Quinnesec, Mich.	700	
	Hamilton, Ohio	530	Half of mill converted
Consolidated	Wisconsin Rapids, Wis.	680	Coated paper
Crane	Dalton, Mass.	120	Three mills
Cross Pointe	Park Falls, Wis.	375	Flambeau Paper
	West Carrollton, Ohio	300	Miami Paper
Domtar	Windsor, Que.	1,102	No. 6 converted; Nos. 7 and 8 by fourth-quarter 1991
Eastern Fine Paper	Brewer, Maine	180	
Ecusta	Pisgah Forest, N.C.	250	Cigarette, thin papers; Division of P.H. Glatfelter
E.B. Eddy	Hull, Que.	250	
Esleek Manufacturing	Turners Falls, Mass.	20	
Finch, Pruyn	Glens Falls, N.Y.	575	
Fletcher Paper	Alpena, Mich.	85	
Georgia-Pacific	Nekoosa, Wis.	575	
	Port Edwards, Wis.	440	Two machines alkaline, two to be converted
P.H. Glatfelter	Neenah, Wis.	410	
	Spring Grove, Pa.	700	
IP/Hammermill	Mobile, Ala.	1,000	
	Selma, Ala.	530	
	Millers Falls, Mass.	30	Strathmore Div.
	Turners Falls, Mass.	—	Strathmore Div., capacity with Westfield; partially converted
	Westfield, Mass.	190	Strathmore Div.; partially converted
	Woronoco, Mass.	160	Strathmore Div.; No. 1 converted, No. 2 in trials
	Moss Point, Miss.	150	
	Corinth, N.Y.	480	
	Oswego, N.Y.	210	
	Ticonderoga, N.Y.	690	
	Erie, Pa.	470	
	Lock Haven, Pa.	675	
	Grays Harbor, Wash.	375	
	Merrill, Wis.	100	Ward Paper Co. division of Strathmore Div.
Island Paper Mills	New Westminster, B.C.	400	Coated/uncoated
James River	Camas, Wash.	698	No. 20 machine
	Gorham, N.H.	450	One machine converted
	Groveton, N.H.	299	
	Wauna, Ore.	249	No. 4 machine
Lyons Falls	Lyons Falls, N.Y.	220	
Mead	Chillicothe, Ohio	400	Chilpaco mill
Midtec (Repap)	Kimberly, Wis.	1,140	Coated free-sheet
Mohawk Paper Mills	Cohoes, N.Y.	120	
	Waterford, N.Y.	110	
Papyrus Newton Falls	Newton Falls, N.Y.	400	
Parsons Paper/NVF	Holyoke, Mass.	35	
Patriot	Boston, Mass.	177	Recycled mill

Continued

er of alkaline technology and builds, operates, and owns onsite satellite plants that produce PCC. D.R. "Randy" Harrison, manager of market development at Pfizer, said alkaline paper represented 22% of uncoated free-sheet capacity in 1988. He expected the figure to rise to 66% of installed capacity by 1990. William C. Sellers, manager of business planning for Hammermill Papers, said that alkaline paper offers excellent optical and physical properties, higher natu-

ALKALINE PRINTING/WRITING PAPER MILLS (continued)

Company	Mill	Capacity (tpd)	Notes
Penntech	Johnsonburg, Pa.	400	Division of Willamette
Potlatch	Brainerd, Minn.	45	
	Cloquet, Minn.	550	Coated paper
Potsdam Paper Mills	Potsdam, N.Y.	n.a.	
Riverside	Appleton, Wis.	120	
Scott/S.D. Warren	Mobile, Ala.	750	Coated machine alkaline
	Hinckley, Maine	1,690	(Skowhegan) Coated paper
	Muskegon, Mich.	n.a.	Coated paper
	Westbrook, Maine	400	Coated paper
Simpson Paper	Anderson, Calif.	420	Coated machine alkaline
	Plainwell, Mich.	250	
	West Linn, Ore.	500	Formerly James River
	Pasadena, Texas	750	
Watervliet Paper	Watervliet, Mich.	114	
Byron Weston	Dalton, Mass.	70	Division of Crane
Westvaco	Tyrone, Pa.	200	
	Wickliffe, Ky.	600	
Weyerhaeuser	Plymouth, N.C.	900	
	Rothschild, Wis.	350	
	Longview, Wash.	360	R-W Papers Div.
Weyerhaeuser Canada	Prince Albert, Sask.	660	
George A. Whiting	Menasha, Wis.	25	
Willamette Industries	Bennettsville, S.C.	800	
	Hawesville, Ky.	500	
Total capacity		**34,379**	
CONVERTING TO ALKALINE			
Champion International	Canton, N.C.	970	
	Cantonment, Fla.	1,025	Pensacola mill
	Courtland, Ala.	1,550	
Fraser Paper	Madawaska, Maine	450	
French Paper	Niles, Mich.	65	
Georgia-Pacific	Ashdown, Ark.	1,350	
	Kalamazoo, Mich.	400	
	Port Hudson, La.	1,400	
International Paper	Bastrop, La.	475	
	Georgetown, S.C.	370	
	Jay, Maine	1,350	Androscoggin mill
James River	Adams, Mass.	40	
	Parchment, Mich.	400	
Lincoln	Lincoln, Maine	170	
Mead	Chillicothe, Ohio	—	Chillicothe mill, combined with Chilpaco mill
	Escanaba, Mich.	1,480	
	Kingsport, Tenn.	550	
Simpson	Pomona, Calif.	340	
Union Camp	Eastover, S.C.	600	
	Franklin, Va.	1,900	
Westvaco	Luke, Md.	1,174	
Total capacity		**83,327**	

n.a. = Not available.
Sources: *Alkaline Paper Advocate*, company data, *Pulp & Paper* estimates.

ral brightness, permanence, bulk improvement, greater stiffness and overall strength, and better printability—all for lower processing costs. He added that alkaline paper can be recycled within the mill operation without significant loss of strength.

ELECTRONIC TECHNOLOGIES

The paperless office is here. Yet businesses are using more paper than ever. These two seemingly contradictory statements are the result of technology meeting reality, that is, information exchange can be performed on a truly electronic level, helping cut down certain types of paperwork, but office workers' and managers' desire or need to see their work in print, combined with the proliferation of computers, photocopiers, and facsimiles, has actually pushed paper use.

On the paperless office side of the issue, electronic data interchange (EDI) is becoming more and more a part of daily business, particularly for documents such as invoices and purchase orders, shipment status inquiries, and even reports of theater box office receipts, according to a consulting firm called "EDI, spread the word!" The number of companies "going paperless" has grown 68% during the past year, according to figures released at the Third International Congress of EDI Users in Brussels, Belgium, the company said. Anna Lee Payne, publisher of the EDI *Yellow Pages*, said the number of companies going paperless in established industries internationally is growing at about 45%/year.

EDI is mostly affecting the business forms industry, which is also plagued by the increased use of intelligent copiers and forms computer software. Some of the loss is made up (for paper companies at least) through increased demand for single-page, cut-sheet copier and computer printer papers, which generally have higher value than standard forms papers. But the business forms converters are having to find new opportunities. "The major direct-selling forms manufacturers [such as Moore Business Forms and Standard Register] have become far leaner and more aggressive than ever before," according to Douglas Taylor, vice president of the trade group International Business Forms Industries Inc. "Now that the intelligent copier/

ELECTRONICS-RELATED SPECIALTY PAPERS: NORTH AMERICAN MARKET SIZE AND STRUCTURE

(000 short tons)

	1988	1989	1990	1991	1992	1993	1994	1995	Compound annual growth 1989-94 (%)
Cut-size[1]									
IC/P*	511	641	805	982	1,186	1,382	1,543	1,723	29.6%
Ink jet	6	11	18	26	36	49	65	85	164.6
Impact**	149	163	175	179	177	169	160	151	0.2
Copiers	1,691	1,820	1,939	2,045	2,142	2,231	2,313	2,397	5.2
Duplicators	402	360	318	278	236	196	157	119	-8.8
Typewriters	142	134	122	109	96	86	80	75	-5.9
Total	2,901	3,129	3,377	3,619	3,873	4,113	4,318	4,550	7.1
Continuous forms									
Stock	1,504	1,611	1,674	1,718	1,737	1,741	1,713	1,687	1.5
Single-part	1,083	1,203	1,279	1,341	1,377	1,403	1,404	1,405	3.7
Multipart	421	408	394	376	360	338	309	282	-4.1
Custom	1,498	1,517	1,531	1,538	1,522	1,495	1,453	1,414	-0.7
Single-part	693	728	754	772	779	783	782	782	1.6
Multipart	805	788	777	766	743	712	671	632	-2.7
Total	3,002	3,128	3,205	3,256	3,259	3,236	3,166	3,101	0.4
Facsimile papers									
Thermal	21	33	47	60	73	83	89	96	44.6
Plain paper[2]	2	3	5	11	21	39	64	105	643.8
Thermal transfer[2]	3	3	2	2	2	2	3	3	0.0
Total	26	39	54	73	96	124	156	204	85.6
Electrostatic paper	**21**	**24**	**27**	**30**	**33**	**37**	**40**	**44**	**13.7**
Total all	**5,950**	**6,320**	**6,663**	**6,978**	**7,261**	**7,510**	**7,680**	**7,899**	**4.1**

Note: Figures include both cut-size and continuous forms.

*Intelligent copiers/printers, including laser.

**Such as dot matrix.

1. Not including facsimile papers below.

2. Cut-size papers.

Source: BIS Strategic Decisions.

POTENTIAL IMPACTS OF ELECTRONIC AND COMPUTER TECHNOLOGY ON PAPER CONSUMPTION

	Use	Equipment	Grades and end uses affected
MESSAGES			
Electronic mail	Office	Microcomputer and modem	Some loss in first-class mail and copy paper
Voice mail	Office	Same as above	Same as above
Facsimile	Office	Fax equipment	Specialty papers; some loss in first-class and express mail
Colored copying	Office	Special copiers	Specialty papers
Work office	Office/home	Word processors, microcomputers	Copy, bond, forms
INFORMATION			
Database + optical or magnetic storage disks	Directories, catalogs	Microcomputer coupled with up-to-date database	Forms, groundwood papers, business-to-business directories and catalogs
Wide-area networks	Telephone directories, interchange of data	Microcomputer or telephone-supplied equipment coupled with mainframe computers	Telephone directories
Videotext	A. General information B. News/editiorial C. Classified advertising D. Electronic shopping	Microcomputer coupled with mainframe computers with large databases	A. Forms, publications B. Newspapers, magazines, references C. Newspapers D. Catalogs/coated, groundwood papers
Optical/magnetic disk storage	Office files and records	Scanners and optical/disk storage, plus microcomputers	Label, security papers, copy, file folder, index
Electronic data interchange (EDI)	Invoicing, purchasing inventory, financial reporting	Computers	Forms, business papers
OCR/MICR	Banking, inventories, sales	Scanners, computers	Label, security papers, forms
PUBLISHING			
Desktop	Offices, publishers	Microcomputers, laser printers	Copy, coated, photographic
Videotext	Home	Microcomputer coupled with large databases	Books, magazines, newspapers
Laser printers	Office	Nonimpact printer	Bond/copy, forms
High-resolution TV	Home	TV receiver	Less print

printer has gobbled up much of the high-volume, highly profitable contracts from Fortune 500 companies, the major forms producers have been forced to move 'down market' to search out new markets," Taylor told delegates of *Pulp & Paper*'s White Papers II conference in April 1991. Taylor added that an IBFI study indicated companies in the Fortune 1000 expected to increase business forms expenditures by just 4.3%/year through 1991, while 80% of the companies planned to increase acquisition of cut-sheet intelligent copier/printers. And since EDI is most often adopted by the largest companies in the hopes of big cost savings, those large orders of business forms are cut drastically.

Most Fortune 500 firms now use corporate videotext systems. Estimates of videotext growth predict a $2- to $3-billion industry by 1996. In fact, paper companies and their customers are taking advantage of electronic data exchanges in the forms of EDI, electronic mail (E-mail), online transaction processing, fax, and bar coding for inventory control and distribution.

As a result of these changes, business forms product shipments have undergone substantial change, with focus on single-part custom and stock continuous forms that run on computer printers and the decline of multipart unit sets, according to Taylor. Of course, cut-size paper will also benefit since it is used in laser (page) printers and copiers.

GRADES/END USES

OFFSET PAPERS

Offset printing papers are used for books, tablets, brochures and direct mail, and envelopes. The machines that make cut-size and related papers can also produce offset grades. Properties that distinguish grades include surface finish, opacity, brightness, and bulk. Offset papers are sold either in rolls or in sheets (cut or folio sizes), with rolls making up somewhere close to 70% of all offset paper shipments. Paper roll diameter and width must be standardized to meet the needs of printers. For stock roll grades, typical diameters are 32 and 40 in. Standard widths are 11, 17, 22, and 35 in. Buyers usually pay a trim penalty when ordering unstocked sizes.

Offset and other uncoated book papers are designed to run on high-speed offset presses. The sheet surface is sized externally at a size press on the paper machine to prepare it for the slight wetness inherent in offset printing. And offset papers must have a high degree of resistance to picking.

Opacity is produced by TiO_2 and other fillers. Quality and price of the sheets vary because of the wide array of furnishes, fillers, and brightness levels available. Opacified offset paper is often preferred because it has a slightly higher brightness and a 2% to 3% higher opacity rating than standard offset book paper. Mills may make several grades to meet the specific requirements of printing quality and price. Uncoated book papers also vary in bulk and sheet surface, with bulk influenced by changes in basis weight as well as in

U.S. CONSUMPTION OF THERMAL PAPER

($/short ton)

End use	1988 000 tons	1988 million $	1991 000 tons	1991 million $	1993 000 tons	1993 million $	% change 1988-93 (tons)
Facsimiles	22.0	$264	58.0	$638	84.7	$847	285.0%
Charting	3.8	73	4.6	83	5.3	90	39.5
Bar codes	7.3	182	11.1	255	14.7	323	101.4
Tickets/tags	2.0	30	4.5	85	7.5	135	275.0
Printers/calculators	6.0	62	4.0	36	3.8	30	-36.7

Source: Ricoh Electronics Inc.

PRODUCERS OF FACSIMILE PAPERS

Company	Location	1991 estimated tonnage Capacity	1991 estimated tonnage Production	Market share*
Appleton Papers[1]	Appleton, Wis.	25,000	20,000	32%
Kanzaki Papers	Ware, Mass.	20,000	10,000	26
Ricoh	Santa Ana, Calif.	15,000	12,000	19
Nashua Corp.	Nashua, N.H.	5,000	4,500	6
Azon Corp.[2]	Johnson City, N.Y.	3,600	n.a.	5e
3M/Lanier	St. Paul, Minn.[3]	3,000	1,500	4
NCR Corp.	Miamisburg, Ohio[4]	3,000	2,500	4
Labelon Corp.	Canandaigua, N.Y.	2,500	2,500	3
Total		**77,100**	**53,000**	**100%**

e = Estimate.
*Based on capacity.
1. Appleton also produces the basepaper.
2. Licensed by Ricoh.
3. Headquarters location.
4. Systemedia Group, headquarters location.
Source: *Pulp & Paper* estimates.

surface treatment. Common sheet surfaces include antique, eggshell, woven, and English.

Mechanical pulp in the furnish produces lower-price offset paper that retains relatively high opacity levels but has a lower brightness rating. Many mills have started adding recycled fibers, including up to 10% postconsumer or deinked fiber, and often charge a premium for the paper.

More than 2.6 million tons of uncoated offset paper were shipped in 1990, a 4% increase from 1989. Uncoated free-sheet shipments to book publishers totaled about 510,000 tons, a decrease of about 10% following a similar drop from 1988. Uncoated free-sheet represented over 50% of the 960,000 tons of paper shipped to book publishers in 1990, a drop from 1989. Shipments of uncoated free-sheet paper (mostly offset in sheets and rolls) to commercial printers dropped less than 1% in 1990 after a 2% decline in 1989. Offset shipments are likely to advance about 3.4%/year in the decade of 1991-2000.

BMDX PAPERS

Bond, mimeograph, duplicating, and xerographic (BMDX) grades are similar to offset in sheet property and basis weight, and many mills make the same paper for more than one end use. These grades are internally and surface sized because they are also commonly used for offset printing.

BMDX papers are generally made from 100% chemical pulp, with both opacity and brightness in the mid- to high eighties. Some cotton fiber may be used in high-quality bond papers (see chapter on Cotton Fiber). In addition, some lower grades may use a small amount of mechanical or chemi-thermomechanical pulp furnish, and many are now including recycled fibers.

Demand for bond paper will increase approximately 4.3%/year through 2000, while the other BMDX grades (including ledger) will see annual shipment decreases of 2.1%.

As indicated in the accompanying statistics supplied by BIS Strategic Decisions, standard photocopiers, intelligent copiers/laser printers, and ink jet printers will lead the growth in demand for bond papers, with compound annual growth rates (CAGR) at 5.2% for the more mature copier market and as high as 165%/year for the small but rapidly growing ink jet area.

Thermal and other specialty papers related to electronic data transmission and printouts, made with a base of uncoated free-sheet paper, will perform better than both cut-sheet and forms markets, according to BIS. Demand for thermal facsimile paper in the U.S. will rise from 21,000 tons in 1988 to 96,000 tons in 1995, a 45% CAGR (however, plain copy paper for fax machines will increase from just 2,000 tons in 1988 to 105,000 tons in 1995, a CAGR of 644%). Canadian thermal paper demand will advance 15% to 20%/year, rising to just under 8,000 tons in 1994.

Electrostatic paper will post a 14% CAGR from 1988-95, ending the period at 44,000 tons in the U.S.

TYPICAL GRADE STRUCTURE FOR 100% FREE-SHEET OFFSET PAPERS

Basis weight (lb, 25 x 38 in., 500 sheets)	Grammage (g/m^2)	Opacity[1] (%)
35	52	82%
40	59	86
45	67	87
50	74	89
55	81	91
60	89	90
70	104	92
80	118	94

1. Government specifications for offset book printing paper; however, these are similar to those used by most companies for high-quality offset with brightness of 80 to 85.

MAJOR PAPER GRADES AFFECTED BY ELECTRONIC COMPETITION: U.S. SHIPMENTS

(000 short tons)

	1989	1988r	1987	1986	1983	1980	1975
Newsprint	6,088	5,982	5,842	5,630	5,167	4,672	3,691
Groundwood specialties							
Directory	662	643	605	600	450	450	300
Catalog	498	488	540	540	425	375	300
Groundwood forms	170	171	230	325	240	230	75
Groundwood book	90	82	65	70	125	130	130
Uncoated free-sheet							
Forms bond	2,097	2,110	2,133	2,100	1,700	1,500	950
Envelope stock[1]	905	929	907	850	700	660	460
Offset book	2,525	2,739	2,736	2,634	2,210	2,000	1,450
Bond and writing	2,812	2,803	2,619	2,375	1,840	1,800	1,000
Tablet	365	378	425	400	400	325	230
Coated paper							
Nos. 1 to 4, two side	3,244	3,179	3,150	2,760	2,300	1,800	1,200
No. 5, two side	3,535	3,478	3,300	3,120	2,960	2,400	1,650

r = Revised.

1. Does not include brown, bleached, or semibleached kraft envelopes.

Sources: *Pulp & Paper Forecaster*, Newsprint Information Committee, Canadian Pulp & Paper Assn., American Paper Institute.

FORMS BOND

Forms bond and copy paper are made on the same paper machines, but forms bond is less expensive because it has less filler and for other reasons. Forms bond is used on high-speed, continuous data processing equipment that employs direct-impact printing methods. Desired qualities include stiffness and strength for fast feeding and printing and for refolding without distortion, lint-free printing surface, proper dimensional stability for perfect register, and a high degree of paper cleanliness.

Top-quality forms bond is produced from 100% chemical pulp fiber, often made by blending softwood and hardwood kraft pulps. Forms paper also may have some secondary (recycled) fibers, groundwood pulp, or BCTMP to reduce both production cost and sales price. The price for blended (free-sheet/groundwood) forms sheets can be 25% below free-sheet bond in a normal market. Forms papers made substantially of groundwood pulp are priced around 50% below free-sheet.

Groundwood forms paper may not always be surface-sized, thus reducing printing press runability and printability. Groundwood paper also has lower brightness and opacity than the free-sheet product. However, groundwood forms paper made up less than 6% of the approximately 3 million tons delivered to forms converters in 1990. Abitibi-Price Inc. is essentially the only major groundwood forms paper producer. Forms bond represented a little more than 18% of all uncoated free-sheet shipments in 1990.

BIS estimates that stock continuous forms will advance at a 1.5% CAGR in 1988-95, with single-part forms growing by 3.7% CAGR to 1.4 million tons of paper. Multipart stock continuous will decline 4.1%/year. Custom continuous forms, which overall will account for 1.4 million tons in 1995, will post a decline of 0.7% CAGR, although single-part custom continuous will post a CAGR of 1.6% in the 1988-95 period.

FORMS BOND: TYPICAL GRADE STRUCTURE

Basis weight (17 x 22, 500)	Grammage (g/m²)
9	34
10	38
12	45
15	56
16	60
18	68
20	75
24*	90
28*	105
32*	120

*Ledger/tag weights.

COMMON BASIS WEIGHTS FOR BMDX GRADES

Basis weight (17 x 22, 500)	Grammage (g/m²)	Bond	Mimeograph	Duplicating	Copy
13	49	X			
16	60	X	X	X	
18	68	X	X	X	
20	75	X	X	X	X
24	90	X*	X		X
28	105	X*			
32	120	X*			
36	135	X*			

* Ledger grades.

CARBONLESS PAPER

Carbonless paper is a high-growth area. It has significantly overshadowed carbon-interleaved paper for multipart forms applications (especially in computer printers that have difficulty printing and feeding thicker multipart forms). In 1990, carbonless paper and basestock accounted for more than 730,000 tons of uncoated free-sheet shipments—an increase of nearly 5% in just one year following similar growth over the last 20 years. As a result, one-time carbonizing (OTC) paper saw 1990 shipments plunge almost 11% from 1989, a similar figure to previous years. Shipments of carbonizing paper were about 75,000 tons in 1990.

A top, or donor, sheet is used to transfer the image to succeeding sheets via encapsulated dye coated onto the back side of the paper. When the top surface is imprinted, the pressure breaks the dye on the back, and the image is transferred to the top of the next sheet. The receiving side is coated with kaolin clay to enhance the sharpness of the received image. This system makes up to five replicas.

A carbonless forms unit generally has a basestock coated on the back (CB) made from high-quality chemical pulps on a standard fourdrinier paper machine. The receiving sheet is coated on the paper machine, and the stock then goes to an off-machine coater for the encapsulated dye. When more than two sheets are desired for a set of forms, the intermediate sheets are coated on the front with kaolin and on the back with dye (CFB). The last sheet is coated on the front (CF) but not on the back, with a top coating to receive the image.

Appleton Papers Inc. is both the leading producer of carbonless basestock and a major converter, as is Mead Corp. The companies apply the dye on off-machine coaters and then roll the paper into sets. Other major converters include 3M Co., Moore Business Forms (about 240,000 to 250,000 tpy), Standard Register Co., and

Nashua Corp. Mead produces about 150,000 tpy of basestock. Several producers have started including various dye colors, offering black- and red-image carbonless in addition to the more traditional blue image. Moore and Standard Register are among firms actually switching from blue- to black-image paper.

LIGHTWEIGHT PRINTING GRADES

Lightweight printing (LWP) grades, with basis weights around 40 lb (25 x 38 in., 500 sheets) and 15 lb for forms bond, are used for products ranging from bibles to business forms. However, as multipart business forms give way to single-part forms requiring stronger surfaces, LWP grades are less favored.

Fillers are used to a great extent in LWP grades since opacity should be about 85% when the paper has more than a 26-lb basis weight. Lighter papers, ranging from 19 to 24 lb with opacities of 80% to 85%, are used for bibles. Lightweight grades are additionally used when page weight and bulk must be reduced in books and catalogs. Fibers used to make LWP grades include chemical pulps, cotton fiber, flax straw, or combinations of these. Production figures on lightweight grades are not broken out from uncoated free-sheet statistics.

COVER AND TEXT PAPERS

Cover and text papers are used as covers for magazines, pamphlets, and paperback books as well as for text pages in these publications. They have heavier basis weights than

CARBONIZING BASESTOCK AND CARBONIZING TISSUE PRODUCTION

(000 short tons)

Year	Carbonizing	Carbonless
1990	73	738
1989	83	700
1988	97	689
1987	109	600
1986	117	539
1985	125	498
1984	141	443
1983	150	390
1982	180	370
1981	180	320
1980	181	295

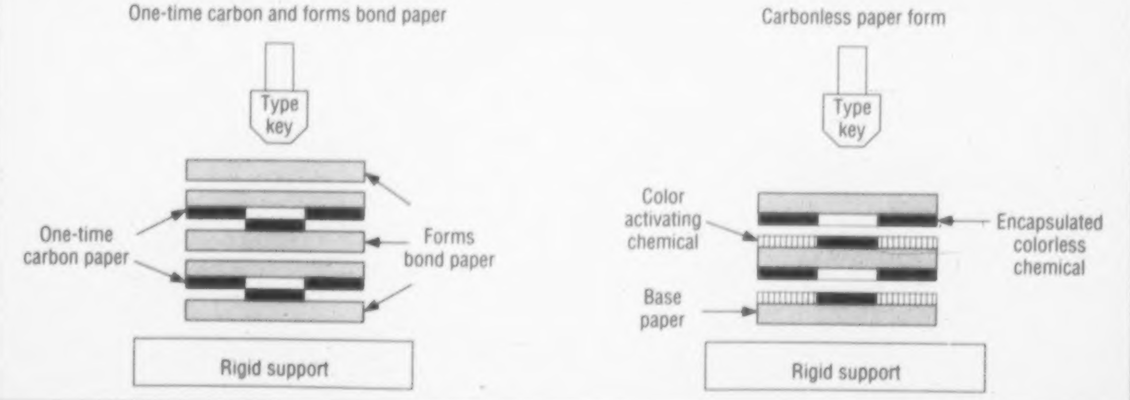
Source: *Pulp & Paper* estimates.

BASIS WEIGHT AND BULK OF LWP PAPERS

Basis weight (lb, 25 x 38 in., 500 sheets)	Typical bulk (sheet/in.)
19* (28 g/m²)	1,360
20* (30 g/m²)	1,290
22* (33 g/m²)	1,180
24* (36 g/m²)	1,080
26 (38 g/m²)	900/940
28 (41 g/m²)	870/900
30 (44 g/m²)	810/850
33 (49 g/m²)	740/790
35 (52 g/m²)	690/700
40 (59 g/m²)	610/640

*Bible grades.

STRUCTURE OF ONE-TIME CARBON AND FORMS BOND PAPER VS CARBONLESS PAPER


One-time carbon and forms bond paper

Carbonless paper form

standard offset papers. Some cover grades come close to bristols, which are discussed in another chapter. Cover stock can be embossed, coated, plastic-coated, or laminated with cloth. Typical basis weights are 70 lb and 80 lb (25 x 38 in.) for text and 65 lb and 80 lb (20 x 26 in.) for cover stock.

Cover and text papers provide better quality for a higher price than offset paper. They are made in a variety of colors and finishes and are manufactured by the same companies that make offset and bond papers. Bleached board producers such as Federal Paper Board and Temple-Eastex Inc. also make cover stock, especially coated cover.

Demand for cover and text grades grew about 6.8%/year in 1981-90 and is projected to advance at a slower 3.0%/year from 1991-2000, reaching 597,000 tons in the year 2000, after hitting about 400,000 tons in 1989 and 1990. Text papers represented about 57% of the combined 1990 tonnage.

THIN PAPERS

Thin paper grades are OTC tissue (99% of thin paper shipments in the U.S), cigarette and condenser papers, bible paper, and papers for specialized uses, such as lens cleaning and stencils.

As mentioned, demand for OTC has declined as carbonless takes over for OTC in multipart forms. Carbon paper is produced by coating carbon black or pigments onto a bleached or unbleached basesheet and then combining the basesheet with a bond sheet. Shipments of thin papers have been dropping between 10% and 15%/year, accounting for just 80,000+ tons of paper.

Basis weights for thin papers vary widely, but a typical weight (20 x 30 in., 500 sheets) is 8.65 lb. The sheet is made on a yankee fourdrinier paper machine at medium speeds of 2,000 fpm. Chemical furnish is used (although some carbonizing tissue can be groundwood based) and is refined to form a tight sheet devoid of pinholes.

Cigarette papers are highly filled, lightweight papers made largely from flax straw. Use of substantial amounts of fillers, such as PCC, controls the burning rate. Conventional cigarettes use three types of paper. Two U.S. mills produce

U.S. PRODUCTION OF UNCOATED COVER AND TEXT PAPERS

(000 short tons)

Year	Cover	Change (%)	Text	Change (%)
1990	174	2.0%	229	2.0%
1989	170	57.4	224	13.7
1988	108	-1.8	197	1.0
1987	110	8.3	195	8.3
1986	96	14.6	180	5.9
1985	87	3.3	170	2.9
1984	90	5.9	175	9.4
1983	85	13.3	160	18.5
1982	75	—	135	6.9
1981	75	1.3	145	10.5
1980	76	5.0	162	0.5
1979	80	8.1	163	18.1
1978	74	8.8	138	13.1
1977	68	19.3	122	2.5
1976	57	32.6	119	5.3
1975	43	17.3	113	29.8
1974	52	5.5	161	2.4
1973	55	12.2	165	13.0
1972	49	14.0	146	5.8
1971	43	—	138	—

Source: *Pulp & Paper* estimates.

PRODUCERS OF LWP AND THIN PAPERS

Company	Mill(s)	Products[1]
Champion International	Deferiet, N.Y.	LWP
Dexter Paper	Windsor Locks, Conn.	SP
Ecusta[2]	Pisgah Forest, N.C.	B, C, LWP, SP
E.B. Eddy	Port Huron, Mich.	CA, LWP, SP
Fletcher Paper	Alpena, Mich.	B, CA, SP
Fox River Paper	Appleton, Wis.	SP
Fraser Paper	Madawaska, Maine	B, CA, SP
P.H. Glatfelter	Neenah, Wis.	LWP
Grays Harbor Paper	Hoquiam, Wash.	SP
Kimberly-Clark	Lee, Mass.[3]	C, LWP, SP
	Spotswood, N.J.[3]	C
	Ancram, N.Y.[3]	C, SP
	Neenah, Wis.	B, SP
Port Huron Paper	Port Huron, Mich.	CA, LWP, SP
Rhinelander Paper	Rhinelander, Wis.	SP
Seaman Paper	Otter River, Mass.	LWP

1. B = Bible, C = Cigarette (includes various papers), LWP = Lightweight printing, CA = Carbonizing, T = Thin, SP = Specialty, technical, and other (including printing/writing)
2. Division of P.H. Glatfelter Co.
3. Schweitzer Div.

COVER AND TEXT PAPERS: TYPICAL GRADE STRUCTURE

Text		Cover	
Basis weight (25 x 38, 500)	Grammage (g/m²)	Basis weight (20 x 26, 500)	Grammage (g/m²)
60	89	50	135
65	96	60	162
70*	104	65*	176
75	111	80*	216
80*	118	90	243
100	148	100	270

*Major weights.

cigarette papers: P.H. Glatfelter Co.'s Ecusta Paper Div. and Kimberly-Clark Corp.'s Schweitzer Div.

Cigarette smoking in the U.S. has declined because of government restrictions and repeated health warnings. However, exports are pushing cigarette paper sales now that certain trade barriers have been reduced or eliminated with Japan, Rep. Korea, and other countries. Elimination of trade barriers is important because cigarette smoking is declining in the U.S. at about 1% to 2%/year. However, the opening up of Eastern Europe will also probably help U.S. cigarette manufacturers (and, thus, paper producers) since, as with Japan, American cigarettes have a bit of cachet associated with them.

Bible and other thin printing papers are growing very slowly, although bible papers received a bit of a boost from the Persian Gulf War in 1991. Despite the drop in demand for most thin paper grades, prices have remained stable. Production costs are growing faster than some prices. Prices for thin papers have generally not kept pace with increases for other printing/writing grades.

Electrical paper includes several grades, such as insulating, condenser, capacitor, and dielectric. Production of these papers probably is less than 20,000 tpy combined. Some electrical papers, such as insulating paper, are listed under "special industrial papers," and their tonnages are discussed elsewhere in this book.

PAPER DISTRIBUTION

Because uncoated free-sheet papers are the largest segment of printing/writing grades and commodity offset and cut-size copy paper are prevalent in society, anything impacting their distribution impacts distribution of printing/writing papers as a whole. Thus, it is advisable to look at issues affecting the paper merchant business.

One of the most important issues is the relationship between paper mills and merchants, who act as intermediate agents between mills and printers, converters, and large end users. Both paper manufacturing and distribution businesses have been in a period of reorganization and consolidation, with both vertical and horizontal alliances being built or broken. An interesting relationship has resulted, according to Mark Fuller, executive vice president at Champion International Corp.

"It strikes me that the inherent nature of the relationship between the paper mill and the distributor is one built in conflict," Fuller said at the White Papers conference. "There are, in fact, legitimate and opposing points of view." Fuller said to delegates, including a number of merchants, "I don't think there is anything such as a generic mill. I don't think there is such a thing as a generic paper distributor. There are, in fact, all kinds of variations on the theme. Many, many mills, my own included, sell direct through distribution, through brokers, and any other way we can find to take our product to market, depending on the circumstances.

"The future of the distribution business, in my view, is

U.S. BUSINESS FORMS SALES, 1989-94

(in millions of 1989 dollars at shipment values)

Product	1989	1990*	1991*	1992*	1993*	1994*	% change 1989-94
Custom continuous	3,621	3,697	3,782	3,876	3,969	4,068	12.3%
Stock continuous	1,940	2,001	2,069	2,153	2,236	2,318	19.5
Unit sets	1,782	1,773	1,742	1,736	1,718	1,706	-4.3
Sales books/pegboard	369	376	388	404	423	446	20.9

*Forecast.
Source: International Business Forms Industries Inc.

UNCOATED FREE-SHEET PAPER BY END USE

(000 short tons)

	1990	1989	1988	1987	1986	1985	1984	1983
Office reprographics	2,737	2,389	2,369	2,253	2,012	1,830	1,749	1,690
Commercial printers	2,778	2,816	2,857	2,741	2,521	2,441	2,355	2,164
Business forms converters	2,746	2,723	2,793	2,784	2,716	2,427	2,278	2,134
Envelope converters	1,120	1,087	1,164	1,124	1,085	998	990	920
Book publishers	513	566	630	557	569	455	482	437
Stationery and tablet converting	444	429	377	421	417	445	291	377
All other (includes exports)	1,172	1,171	1,087	1,086	1,090	1,094	1,007	1,004
Total shipments	11,510	11,181	11,277	10,966	10,410	9,690	9,152	8,726

Sources: Dean Witter Reynolds/American Paper Institute in the hands of the distributor," Fuller said. "The distribution function has already demonstrated its worth. It is a proven function that happens in the economy of this country and in the world. No apologies are needed. But remember, performing an economic function or, putting it another way, adding value in the economic chain is what distribution is all about."

Perhaps a bit irritating to merchants, Fuller added that he believes "the distributor is an extension of the mill's own sales and marketing effort. First and foremost, the distributor performs an economic function for the manufacturer. The manufacturer, in this case the mill, engages the professionalism and the skills of the distributor because the manufacturer has elected to, on its own, or has concluded on its own, that it cannot take the products that it manufactures at its mills to market as efficiently or as effectively on its own. In other words, it is the mill's call as to whether or not the mill uses distribution."

Fuller explained that mills expect product exposure in the marketplace. But mills make more than one line, and distributors (even mill-owned merchants) do not necessarily carry the full line but may carry a competitor's line(s).

Second, mills want "account coverage" by their distributor, especially since many mills have invested in upgrading or adding capacity. But merchants may already be selling the account a mill wants to another of its supplier mills. It also works the other way, Fuller said, with merchants wanting support for selling an account, even if a mill's other merchant is already selling that account.

Third, Fuller thinks merchants should handle their clients' credit without mill intervention if that's what they want. Merchants often finance a customer's purchase or decline to sell to someone with questionable credit, even if the mill would prefer the reverse.

The fourth issue is inventory. "It seems to me, along with credit, there isn't any more important function performed by distribution than inventory," Fuller said. "Of course, not every grade needs to be inventoried and not every mill that you do business with requires inventory. But for all intents and purposes, why else have distribution unless distribution is going to perform the inventory function. The mill wants to get product X closer to a marketplace. Closer to somebody who's actually going to do something with it. This, of course, is what distribution does—gets the product closer to the marketplace. Here is where the distributor performs that very important economic function." But merchants do not necessarily want to carry a lot of inventory, especially in down cycles, because they typically finance those inventories through borrowing and because price cutting could affect sales of that inventory.

Service is the fifth important area and "means a lot of things to a lot of people. Presumably, everybody's level of service is competitive or else they don't stay in business. But the mills obviously want their distributor to have the best delivery in town. They want to have the best city order desk in town. They want to have the best mill order desk in town. They want to have a warehouse that doesn't damage the product on the way to the customer, etc.," Fuller said. He noted that the mill has to help the merchant provide service to its own customers.

PAPER SHIPMENTS TO U.S. BOOK PUBLISHERS, 1980-90

(000 short tons)

Year	Coated two side Total	Coated two side Nos. 1-4	Coated two side No. 5	Uncoated free-sheet	Uncoated groundwood	Total
1990	341	248	83	510	112	963
1989	286	235	51	570	90	946
1988	320	263	70	630	82	1,032
1987	300	245	53	560	70	930
1986	298	238	60	524	68	890
1985	280	223	57	454	53	787
1984	289	219	70	482	70	841
1983	250	190	60	435	75	760
1981	250	165	85	460	105	815
1980	240	150	90	475	115	830

Source: *Pulp & Paper* estimates.

TYPICAL BULKS FOR BOOK PAPERS AT DIFFERENT BASIS WEIGHTS AND SHEET FINISHES

Basis weight (25 x 38, 500)	Standard bulks Antique (ppi)*	Standard bulks Eggshell (ppi)*	Standard bulks Standard (ppi)*	Standard bulks English finish (ppi)*
45	—	492	540	600
50	410	440	488	540
55	360	386	444	500
60	330	364	408	440
70	288	316	350	390

*ppi = Pages (sheets) per inch.
Source: International Paper Co.

Paper:

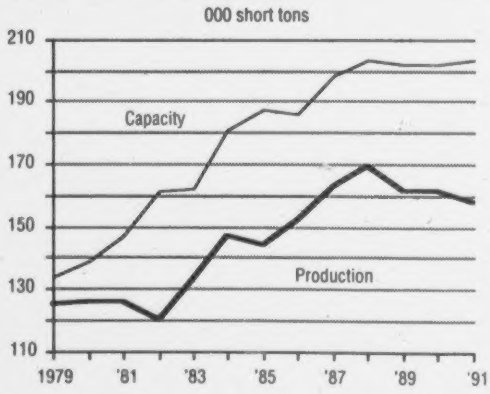
COTTON-FIBER

Papers containing 25% to 100% cotton fiber are classified in the cotton-fiber category, separate from uncoated free-sheet, though the two are closely related. These grades are sold primarily as premium-writing bond paper but also have applications in technical and specialty uses that require permanence and durability. These uses include paper currency, financial certificates, and postage stamps.

Cotton-fiber paper is considered by some to be one of the original recycled papers because old rags (thus the term "rag bond") and other fabric castoffs were used to produce it. Nowadays, cotton fiber is composed of cuttings from the textile and garment industries. Fabric sources include unbleached muslin, white-shirt cuttings, light prints, and blue denims. Fiber also comes from cotton linters, which are the short fibers that adhere to cotton seed after the ginning operation. Cotton linters consist of the stumps or bases of the longer staple textile fibers and short fuzz fibers.

Cotton is the purest natural form of cellulose (98% to 99% alpha content) used in the textile industry, whether in the form of cotton linters or staple fibers. The high cellulose content gives cotton-content paper its durability. The cotton fiber is usually blended with sulfate or sulfite woodpulp (such as that used in free-sheet grades) and then highly refined or beaten to develop a sheet with crackle and good strength. It is sized internally (beater sizing) to produce a

CAPACITY AND PRODUCTION, 1979-91



Source: American Paper Institute.

COTTON-CONTENT PAPERS: GRADE DISTRIBUTION

(short tons)

Year	Total cotton-fiber	Bond and writing
1992e	178,000	149,000
1991e	158,000	133,000
1990	161,000	135,000
1989r	161,000	135,000
1988r	169,000	141,000
1987	163,000	136,100
1986	152,000	125,400
1985	144,100	117,400
1984	147,200	119,400
1983	132,700	105,900
1982	120,200	94,800
1981	125,600	95,300
1980	126,300	95,200
1979	124,600	93,100
1978	114,400	84,400

e = *Pulp & Paper Forecaster* estimate.
r = Revised.
Sources: American Paper Institute; Dept. of Commerce.

proper level of ink holdout. For a cockle finish, the sheet is air-dried.

Cotton-content papers are made in basis weights of 9, 13, 16, 20, and 24 lb (17 x 22 in., 500 sheets) and can have one of several finishes: light cockle, cockle, smooth, vellum, and linen. Cotton-content papers are also categorized according to their colors (whiteness) and sheet properties (opaqueness).

Not more than 20 companies produce significant tonnage of cotton-fiber papers. Most mills are small in size and located in the Northeast and upper Midwest. These mills can also produce bond-type grades from 100% chemical-pulp furnish, so production is determined mainly by demand rather than by capacity.

The cotton-content paper sector has remained small, with just slight variations in growth or shrinkage. According to the American Paper Institute, shipments remained at 161,000 tons in 1989 and 1990, dropping 5% from the 169,000 tons shipped in 1988. The economic recession impeded growth in 1990, as demand for most printing/writing papers just matched or fell below previous levels. Approximately 85% of the cotton-fiber paper produced in the U.S. is classified as bond and writing paper, with 25% cotton bond representing the bulk of that sector.

As indicated by the small increase in shipments, U.S. capacity is rising slowly. Cotton-content paper capacity is expected to increase 22%, from 205,000 tpy in 1989 to

NORTH AMERICAN PRODUCERS OF COTTON-CONTENT PAPERS

	Company/mill	Capacity[1] (tons/day)
1.	Georgia-Pacific, Port Edwards, Wis.	440
2.	Rolland, St. Jerome, Que.	386
3.	Miami Paper, West Carrollton, Ohio	300
4.	James River, Groveton, N.H.	300
5.	Howard Paper Mills, Dayton, Ohio	225
6.	Eastern Fine Paper, Brewer, Maine[2]	180
7.	Strathmore Paper, Turners Falls, Millers Falls, Westfield, and Woronoco, Mass., mills[3]	160
8.	Beckett Paper, Hamilton, Ohio[3]	160
9.	Kimberly-Clark, Neenah, Wis.[4]	125
10.	Simpson Paper, Ripon, Calif.	110
11.	Crane & Co., Dalton, Mass.[5]	100
12.	Gilbert Paper, Menasha, Wis.[6]	100
13.	Fox River Paper, Appleton, Wis.	100
14.	Ward Paper, Merrill, Wis.	100
15.	Fletcher Paper, Alpena, Mich.	85
16.	Monadnock Paper Mills, Bennington, N.H.	70
17.	Domtar, Fine Paper Div., Beauharnois, Que.	60
18.	Specialty Coatings, Fitchburg, Mass.	52
19.	Rising Paper, Housatonic, Mass.	50
20.	James River, Adamas, Mass.	40
21.	NVF, Holyoke, Mass.[7]	35
22.	Southworth, W. Springfield, Mass.	25
23.	Curtis Paper, Newark, Del.[8]	22
24.	Esleeck Manufacturing, Turners Falls, Mass.	20

e = Estimate.
1. Total mill capacity including other fine and specialty papers.
2. Thirty-five percent of production is cotton. Division of Preco Corp.
3. Division of IP/Hammermill.
4. Includes Whiting mill in Stevens Point, Wis.
5. Includes Byron Weston Papers, Dalton, Mass.
6. Division of Mead Corp.
7. Parsons Paper Div.
8. Division of James River Corp.

PRICING TRENDS FOR BOND PAPERS

($/short ton)

Year	Forms bond[1]	25% cotton[2]
1991		
2Q	$(640)/930	$2,420
1Q	(700)/930	2,440
1990		
4Q	(820-860)	2,440
3Q	(820-860)	2,440
2Q	(820-860)	2,440
1Q	(820-860)	2,440
1989		
4Q	(800-860)	2,200
3Q	(840)/910	2,200
2Q	(880)/910	2,200
1Q	(880)/910	2,200*
1988		
4Q	(880)/910	2,200*
3Q	850/870	2,200
2Q	850/870	2,125
1Q	800-810	2,125
1987		
4Q	760	1,990-2,060
3Q	760	1,900
2Q	720*	1,810
1Q	720*	1,810
Year-end		
1986	672	1,810*
1985	(640)	1,810
1984	762	1,750
1983	745	1,650/1,730
1982	(640)	1,650
1981	753*	1,549
1980	697	1,490
1979	620	1,343
1978	544	1,210
1977	475	1,143
1976	520	1,083
1975	500	1,012
1974	470	984
1973	—	728
1972	—	719

( ) Estimated transaction price where significant volume moving below list.
*Discounting from list prices reported.
1. Average price for rolls.
2. Average price for sheets.
Sources: *Pulp & Paper Week; Pulp & Paper Pricebook2.*

251,000 tpy in 2000, an average annual increase of 2%.

Some growth in production is anticipated through the rest of the decade, with shipments reaching a projected 178,000 tons in 1992, 196,000 tons in 1995, 212,000 tons in 1998, and 221,000 tons in 2000. However, operating rates will remain below what most commodity grades (such as uncoated free-sheet, offset, or cut-size paper) require to be highly profitable. For the most part, utilization will remain below 90%. In 1989, cotton-content mills operated at an estimated 78.5%. Operating rates are expected to rise to 83.6% in 1992, 87.1% in 1995, 86.5% in 1998, and 88.0% in 2000.

Pricing for cotton-bond papers tends to be slightly less volatile than for commodity papers. Pricing advanced significantly in 1980, with 25% cotton bond in sheets moving to a yearly average of $1,442/short ton from $1,274/ton in 1979. Subsequent years brought increases ranging from 7.4%, to a mere 0.6% in 1983, to no effective increase in 1986. The price for 25% cotton in sheets rose to an average $1,810/ton by year-end 1984, hit $2,200/ton in 1989, and hovered around $2,020 to $2,040/ton by mid-1991.

COMPUTERS AND COTTON

One issue that has surfaced in recent years regarding cotton-content papers is their use with computer laser printers. Since cotton papers naturally have a high fiber content, there has been some concern that if used in laser printers they will leave residual fibers, or lint, behind. These machines are subject to some linting from standard uncoated free-sheet papers anyway, but some printer manufacturers warn against using cotton papers in their machines. The industry has determined, however, that cotton-fiber papers are safe for computer laser printers, and users should not be discouraged from utilizing them, especially for items such as company letterhead.

Paper:

BRISTOLS

Bristol papers are bleached or semibleached kraft stock, slightly lighter in weight than bleached boards but heavier than true printing/writing grades. Bristols may be solid or laminated stock, with thickness or caliper ranging from 6 to 14 pt. Bristol grades are broken down into seven segments: tabulating index, tag and file folder, index bristols, printing bristols, postcard, coated bristols, and mill or bogus bristols, which are bristol-type recycled paperboards made on cylinder paper machines.

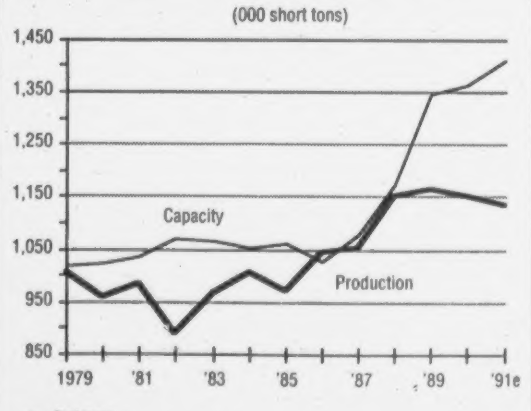
Tabulating stock, used primarily for computer tab cards, must have superior dimensional stability and magnetic encoding capabilities. Tab stock is produced on fourdrinier paper machines from semibleached kraft pulps.

Index bristols have a fairly good printing surface that is extremely erasable. Both tag and index bristols are usually produced on fourdrinier paper machines. Although the grades are similar, tag bristol is stronger and more durable.

Printing bristols are used in a variety of ways. They can be either coated one side (C1S), coated two side (C2S), or uncoated. Printing bristols used for book cover stock have many characteristics similar to other cover grades. Lower-caliper (between 6 and 10 pt) coated bristols are produced on fourdrinier paper machines from a blend of bleached hardwood and softwood kraft pulps. Hardwood improves the printing surface and adds bulk.

Coated bristols have end uses such as calendars, greeting cards, and paperback book and directory covers, and they account for approximately half of total bristol tonnage. Generally, coated bristol grades are produced at large, integrated mills that also produce bleached paperboard or free-sheet paper grades. Bristols produced from recycled fibers

CAPACITY AND PRODUCTION, 1979-91



e = Estimate.
Sources: American Paper Institute, *Pulp & Paper* estimates.

U.S. STATISTICS FOR BRISTOLS

	1991e	1990	1989	1988
Production, 000 tons	1,135	1,152	1,163	1,150
Capacity, 000 tons	1,412	1,365	1,345	1,171
Utilization rate, %	80.4	84.4	86.5	98.2
Imports, 000 tons	4.0	5.0	4.8	4.2
Exports, 000 tons	1.0	1.0	1.1	1.5
Apparent U.S. consumption				
000 tons	1,138	1,156	1,167	1,152
lb/capita	9.0	9.6	9.4	9.4
000 tons/billion $ real GNP (1982)	0.25	0.30	0.29	0.28

e = Estimate
Sources: American Paper Institute, *Pulp & Paper* estimates.

are typically heavier stock and extend the caliper range from 15 pt and higher. They are often produced by smaller mills making specialty paperboard products.

Major producers of bristol grades include International Paper Co., Federal Paper Board Co. Inc., Temple-Inland Inc., Union Camp Corp., James River Corp., Champion International Corp., and several smaller mills. Specialty Paperboard Inc., formerly a division of Boise Cascade Corp., is a major manufacturer of 100% recycled bristol grades used in the manufacture of office products.

OUTLOOK

Overall demand for bristols has grown slowly in recent years, rising about 1%/year during the past decade. The main reason for this sluggish growth is the sharp drop in the market for tabulating card stock, which fell from about 500,000 tons in 1970 (almost half of total tonnage) to only about 30,000 tons in 1989. Excluding tab card, demand for bristols has grown a respectable 5% annually during the last decade, but the growth trend has flattened in the past two years.

Approximately 1.152 million tons of bleached bristols were produced by U.S. mills in 1990, and about 36,000 tons of recycled grades were also produced, according to the American Paper Institute. Operating rates dropped to about 85% in 1989 and 1990 as mills dedicated more capacity to the bristol grades. Because several bleached packaging board producers are selling their products in bristol markets, API attributes the recent decline in operating rates to the transfer of some bleached board capacity to bristol capacity.

Demand for coated and uncoated printing bristols is growing across a wide range of applications, including paperback book and directory covers, greeting cards, promotional inserts, and direct mail materials. Sales of uncoated lottery and airline ticket stock are also enjoying strong market growth, as are most other segments of the commercial printing field. The enormous growth of baseball and other sports cards has also fueled growth in this segment of the paper industry.

The big decline in tabulating card stock reflects displacement by new computer systems that have made tab cards essentially obsolete as a method of data entry and storage. However, this decline has been partially offset by the growth of the ubiquitous office file folder. The rapid growth of the nation's service economy—including finance, communications, retail, and wholesale trade—has fueled the demand for office supplies.

Shipments of bristols for file folders increased from 72,000 tons in 1970 to 221,000 tons in 1990. Index cards, another office supply stalwart, have been slightly weaker. Shipments in 1989 dropped to 108,000 tons, from 117,000 tons in 1988, and declined again in 1990. Coated printing bristols have shown the strongest growth, rising from

U.S. CAPACITY TRENDS FOR BLEACHED BRISTOLS

Year	Annual capacity (000 short tons)	Change (%)
1991e	1,412	3.4%
1990	1,365	1.5
1989	1,345[1]	14.9
1988	1,171	8.5
1987	1,079	5.3
1986	1,025	-3.2
1985	1,059	0.7
1984	1,051	-1.3
1983	1,065	-0.4
1982	1,069	3.3
1981	1,035	4.0
1980	1,024	0.8
1979	1,016	-14.9
1978	1,194	-1.6
1977	1,213	4.1
1976	1,165	—

e = Estimate.

[1] Capacity reallocation from bleached board grades.

Sources: American Paper Institute, *Pulp & Paper* estimates.

BLEACHED BRISTOL PRODUCTION BY GRADES

(000 short tons)

Year	Total	Tabulating	Tag	Folder	Index, printing, postcard	Coated
1990	1,152	—	177	221	228	526
1989	1,163	35	175	221	218	514
1988	1,150	40	185	195	280	450
1987	1,052	50	181	188	276	350
1986	1,043	60	182	178	270	360
1985	970	70	200	164	194	266
1984	1,003	68	214	141	215	302
1983	967	107	215	149	240	217
1982	886	123	181	117	200	213
1981	984	142	194	127	330	290
1970	1,155	500	186	72	218	179
% change 1970-90	0.0%	—	-3.8%	206.9%	4.6%	193.8%

Source: American Paper Institute.

190,000 tons in 1970 to 526,000 tons in 1990.

According to Communication Information Services Inc., a market research firm based in Pleasant Hill, Calif., overall demand for bristols should rise at a 2.3% annual rate during the 1986-95 period, compared with a 1% annual rate during 1976-85. Coated bristols may grow at a somewhat higher 4.4% annual rate.

Capacity increased in 1989 as a result of reductions in other grades, as previously described. In 1988, just before capacity increased, the operating rate for this segment was estimated at 98.2%. In 1990, capacity increased again to 1.365 million tons. API estimates that industry capacity will rise to 1.5 million tons by 1993. Bristol capacity is somewhat hard to pinpoint, however, because of the sometimes arbitrary delineation between bristols and other grades, including uncoated free-sheet, bleached board, cov-

PRODUCERS OF BRISTOL GRADES

Mill bristol*

Beveridge Paper Co.
Indianapolis, Ind.

Boise Cascade Corp.
Sheldon Springs, Vt.
Beaver Falls, N.Y.

Byron Weston Co.[1]
Dalton, Mass.

Lowe Paper Co.
Ridgefield, N.J.

Sonoco Products Co.
Holyoke, Mass.

Index/printing

Boise Cascade Corp.
Brownville, N.Y.
Beaver Falls, N.Y.

Champion International Corp.
Hamilton Ohio

Domtar Inc.
St. Catharines, Ont.
Toronto, Ont.
Beauharnois, Que.

E.B. Eddy Forest
Products Ltd.
Brewer, Maine
Hull, Que.

Federal Paper Board Co. Inc.
Augusta, Ga.
Riegelwood, N.C.

Fox River Paper Co.
Appleton, Wis.

Mead Corp.
Gilbert Paper Co.
Menasha, Wis.

International Paper Co.
Bastrop, La.
Moss Point, Miss.

James River-Fitchburg
Fitchburg, Mass.
Milford, N.J.

Kimberly-Clark Corp.
Neenah, Wis.

Mohawk Paper Mills Inc.
Cohoes, N.Y.
Waterford, N.Y.

Plainwell Paper Co.
Plainwell, Mich.

Rising Paper Co.
Housatonic, Mass.

Rolland Inc.
St. Jerome, Que.

Scott Paper Co.
Mobile, Ala.

Simpson Paper Co.
Vicksburg, Mich.
Miquon, Pa.

Sorg Paper Co.
Middletown, Ohio

Strathmore Paper Co.[2]
Westfield, Mass.

Temple-Eastex Inc.
Evadale, Texas

Union Camp Corp.
Franklin, Va.

Wausau Paper Mills Co.
Brokaw, Wis.

Whiting Paper Co.
Menasha, Wis.

Tag

Boise Cascade Corp.
Brownville, N.Y.
Beaver Falls, N.Y.

Domtar Inc.
St. Catharines, Ont.
Toronto, Ont.

International Paper
Bastrop, La.
Georgetown, S.C.

Island Paper Mills Inc.[3]
New Westminster, B.C.

James River-Fitchburg Inc.
Fitchburg, Mass.

James River Corp.
Warren Glen, N.J.
Milford, N.J

Merrimac Paper Co.
Lawrence, Mass.

Potlatch Corp.
Lewiston, Idaho

Rolland Inc.
Mont Rolland, Que.

Simpson Paper Co.
Miquon, Pa.

Sorg Paper Co.
Middletown, Ohio

Temple-Eastex Inc.
Evadale, Texas

Union Camp Corp.
Franklin, Va.

Postcard

Domtar Inc.
Cornwall, Ont.

Eastern Fine Paper Inc.[4]
Brewer, Maine

Hennepin Paper Co.[5]
Little Falls, Minn.

International Paper Co.
Mobile, Ala.
Ticonderoga, N.Y.

James River Corp.
Hyde Park, Mass.
Hughesville, N.J.

Lowe Paper Co.
Ridgefield, N.J.

Pejepscot Paper
Brunswick, Maine

Sorg Paper Co.
Middletown, Ohio

Wausau Paper Mills Co.
Brokaw, Wis.

* Includes bogus bristols and heavyweight bristols from bleached kraft used for posters, etc.

[1] Division of Crane & Co. Inc.

[2] Division of Hammermill Paper Co.

[3] 50% owned by MacMillan Bloedel Ltd., 50% owned by Fraser Inc.

[4] Division of Eddy Paper Co. Ltd.

[5] Subsidiary of Carlyle Investment Corp.

er/text, and boxboard. Most industry observers suspect that bristol capacity is somewhat higher than officially reported.

Market leaders Federal Paper Board and International Paper produce both coated bristols and lightweight bleached paperboard at large, integrated mills in the South, often shifting production between the two grades when they are made on the same machine. Both companies are making capital investments to improve their product quality and increase their share of the bristol market.

Federal has added new coating equipment at its Riegelwood, N.C., mill, and IP spent $28 million on its coated bristol machine at Moss Point, Miss., to improve quality and raise output. IP plans to broaden its Springhill coated bristol line over a two-year period by adding several new weights. Current debottlenecking and expansion projects at IP's mills in Georgetown, S.C., Texarkana, Texas, and Bastrop, La., will increase uncoated bristol capacity by about 20% in 1991.

Bristol prices hold up better than prices for other related grades of paper and paperboard because it is a specialty market and is less vulnerable to commodity cycles. During the 1981-82 recession, pricing for bristol grades was substantially stronger than for other sectors that suffered from heavy discounting. In fact, some bristol price increases were implemented in early 1982—a time when almost no other printing/writing grades went up in price.

When the economy began recovering in late 1983, coated bristols rebounded sharply, posting a $50/ton price hike effective Jan. 1, 1984. However, weakness in the overall printing/writing papers market later that year caused some price weakness in bristols. Demand picked up in 1986, and a $20/ton price increase went into effect in September and again in October. Additional increases of $40 to $50/ton were implemented in spring and fall of both 1988 and 1989.

Prices of coated printing bristols and uncoated bristols used in file folders, tabulating cards, tag stock, airline and lottery tickets, etc., remained unchanged during 1990 and 1991. Prices vary considerably among bristol grades because of different end uses, basis weights, and printing and converting requirements. In early 1991, coated bristol prices ranged between $1,050 and $1,150/ton, manila file folder stock prices averaged about $710/ton, and manila tag stock sold for about $850/ton.

BRISTOLS: TYPICAL GRADE STRUCTURE

Grade	Uses, basis-weight ranges	
INDEX: (uncoated)	Sales lists, manuals, record folders, file cards.	
	Basis:	25½ x 30½ in., 500
	Weights:	80 lb (145 g/m^2)
		90 lb (163 g/m^2)
		110 lb (199 g/m^2)
		140 lb (253 g/m^2)
		170 lb (307 g/m^2)
		220 lb (398 g/m^2)
TAG: (uncoated)	Tags, ruled forms, time cards, menus, folders, catalog inserts, display cards.	
	Basis:	24 x 36 in., 500
	Weights:	90 lb (146 g/m^2)
		100 lb (163 g/m^2)
		125 lb (203 g/m^2)
		150 lb (244 g/m^2)
		175 lb (285 g/m^2)
		200 lb (325 g/m^2)
POSTCARD[1]: (uncoated)	Return mailers, bills/ statements.	
	Basis:	22½ x 28½ in., 500
	Weights:	57 lb (125 g/m^2)
		67 lb (147 g/m^2)
		80 lb (176 g/m^2)
MILL BRISTOLS[2]: (uncoated or C1S)	Promotional folders, posters, point-of-purchase displays, tent cards, covers, etc.	
	Caliper:	0.008 in.
		0.010 in.
		0.012 in.
		0.015 in.
		0.018 in.
		0.020 in.
		0.024 in.

1. Approximate calipers: 0.009 in. for 67 lb, 0.0075 in. for 57 lb.
2. A wide range of grades, including bogus bristols. The higher-caliper grades, above 15 pt, could be produced on cylinder machines. Also available in higher calipers.

BLEACHED BRISTOLS: U.S. PRICE HISTORY*

Year	Manila tag[1]	Manila file folder	C1S[2]
1990	$850	$710	$980-1,030
1989	850	710	980-1,030
1988	755	620	840-930
1987	715	585	800
1986	715	585	800
1985	675	640	760
1984	675	640	760
1983	675	576	720
1982	581	576	670
1981	581	576	640-670
1980	521-546	521-541	565-585-605
1979	481	481	520

*Published list prices.
1. Rolls, greater than or equal to 125-lb basis weight (24 x 36, 500 sheets).
2. Coated one side, 10-pt. caliper.

Paper:

PACKAGING AND INDUSTRIAL CONVERTING

Kraft packaging and industrial converting papers include a wide range of unbleached and bleached papers and are divided into three general categories: 1) unbleached packaging and industrial converting grades used for grocery bag and sack, shipping sack, wrapping, and other converting papers; 2) bleached packaging and industrial converting grades used for similar end uses; and 3) special industrial papers used in the manufacture of abrasives, electrical insulators, gaskets, filters, and other products. The bleached grades also include glassine, greaseproof, and vegetable parchment papers used for specialty packaging.

Unbleached grades make up nearly 60% of total production, while bleached and specialty packaging grades account for about 20%, and special industrial grades represent about 20%. The most commonplace products made from kraft paper are grocery sacks, shipping sacks, and retail merchandise bags. The four major end uses for unbleached and bleached kraft packaging and industrial converting papers are bag and sack (57% of shipments), shipping sack (25%), wrapping (3%), and other converting (15%).

Kraft papers for bag and sack production are made in many basis weights. Small bags designed to hold 1/4 lb to 25 lb of product are made from paper with basis weights of 30, 35, or 40 lb/3,000 ft^2—equivalent to 49 to 65 g/m^2. In contrast, sacks are designed to hold more product and are made from paper with basis weights of 40 to 80 lb/3,000 ft^2 (65 to 130 g/m^2). Typical sack weights are 40, 52, 57, 65, 70, 75, and 80 lb. Standard grocery sacks use 70-lb kraft paper, while 50-lb paper is used in shipping sacks.

Because bags and sacks are made for many different purposes, their weight, style, and construction are tailored to each end use. Bags and sacks are standardized in four sizes (1/8, 1/6, 1/5, and 1/4 of a bushel) and are primarily produced in one of four styles: flat, gusset, satchel-bottom, and self-opening. Sack construction may also be single-wall, heavy single-wall, duplex, or multiwall. If needed, the machine-direction (MD) strength of kraft paper may be increased during the drying stage of the papermaking process. This extensible kraft paper absorbs more shock without rupturing, and it is used primarily in multiwall shipping sacks.

Multiwall shipping sacks are made of two or more plies of kraft paper, which can be combined with plies of plastic film or other barrier materials. Typically, multiwall shipping sacks hold a minimum weight of 25 lb and are used to ship bulk products, such as cement, chemicals, and agricultural products. Multiwall sacks provide an economical packaging system. Because the layers of kraft paper and plastic film are lightweight, shipping costs are based mostly on product weight alone, and because the multiwall bag is flexible and strong, it can be stacked and pallet-loaded for shipment. Some smaller-size multiwall bags are also used to package coffee, sugar, flour, pet food, and charcoal briquettes for consumer markets.

U.S. STATISTICS FOR PACKAGING AND INDUSTRIAL CONVERTING PAPERS

	1991e	1990	1989	1988
Production[1], 000 short tons	4,474	4,576	4,916	5,033
Capacity[1], 000 short tons	5,615	5,466	5,435	5,402
Utilization rate, %	79.7	83.7	90.5	93.2
Imports, 000 short tons	380	425	407	343
Exports, 000 short tons	325	283	342	347
Apparent U.S. consumption				
000 short tons	4,419	4,434	4,851	5,037
lb/capita	35.3	35.5	39.8	41.1
000 tons/billion $ real GNP (1982)	1.13	1.14	1.24	1.29

e = Estimate.

[1] American Paper Institute, *Pulp & Paper* estimates.

Merchandise bags are specialized types of bags commonly used by department stores and other retail businesses. Typically, these bags are bleached and printed. Bleached kraft papers that are machine finished (MF) or machine glazed (MG) have an excellent glossy printing surface and are used when the appearance of bags or wrapping paper is important.

Wrapping and other converting grades include specialty papers that are often lightweight (25 lb or below) and coated or laminated for moisture, vapor, or grease resistance. These specialty grades are used in consumer and food packaging as well as for labels.

INDUSTRY STRUCTURE

The structure of the packaging and industrial converting industry is fragmented because of the wide range of grades produced. Commodity unbleached kraft bag and sack paper grades are produced mainly at large kraft mills in the southeastern U.S., which may also produce kraft linerboard on the same paper machines. Some unbleached kraft paper is also produced in the Pacific Northwest and in western and eastern Canada.

The largest commodity producer of kraft papers in the eastern U.S. is Stone Container Corp., followed by Union Camp Corp., Georgia-Pacific Corp., International Paper Co., and Gaylord Container Corp. In the Pacific Northwest, Longview Fibre Co., Port Townsend Paper Co., and Simpson Paper Co. are the key producers. Most of these large integrated paper companies also produce some specialty unbleached and bleached packaging and converting papers.

Negative growth rates and low profitability in the commodity unbleached kraft paper segment have caused major industry restructuring through machine conversions and shutdowns and company divestitures. Stone Container has become the largest producer through its acquisitions of unbleached kraft mills formerly owned by Jacksonville Kraft Paper Co. and Continental Forest Industries Inc. At the same time, Stone became the largest integrated manufacturer of paper bags and sacks with its acquisitions of Samson Paper Bag Co., Great Plains Bag Corp., and Trinity Paper & Plastics Corp.

Another sign of life in the grocery bag and sack business is the entry of a major new supplier. Gaylord Container purchased two grocery sack plants in 1989 and will supply these plants from its kraft paper mill at Pine Bluff, Ark. The acquisitions make Gaylord the second largest integrated producer of grocery sacks (behind Stone Container), with the ability to serve markets in the eastern U.S. Meanwhile, Champion International Corp., International Paper, and Georgia-Pacific have substantially reduced their market position by converting paper machines from bleached and unbleached kraft paper production to mostly kraft linerboard and uncoated free-sheet production.

Specialty and industrial. These papers are manufactured at small, nonintegrated mills concentrated in the Northeast and upper Midwest. Demand for the specialty

U.S. TOTAL PRODUCTION AND CAPACITY OF PACKAGING AND INDUSTRIAL CONVERTING PAPERS

(000 short tons)

Year	Production	Capacity	Utilization rate (%)
1990	4,576	5,466	83.7%
1989	4,916	5,435	90.5
1988	5,033	5,402	93.2
1987	4,974	5,492	90.6
1986	5,147	5,758	89.4
1985	5,230	5,985	87.4
1984	5,567	5,991	92.9
1983	5,483	6,078	90.2
1982	5,191	6,076	85.4
1981	5,450	5,947	91.6
1980	5,484	6,072	90.3
1979	5,786	6,053	95.6
1978	5,789	6,146	94.2
1977	5,730	6,242	91.8
1976	5,451	6,202	87.9
1975	4,624	6,368	72.6
1974	5,784	6,360	90.9
1973	5,649	6,060	93.2
1972	5,531	6,028	91.8
1971	5,281	5,963	88.6
1970	5,265	5,940	88.6
1969	5,337	5,840	91.4

Sources: American Paper Institute.

MAJOR U.S. UNBLEACHED KRAFT PAPER CAPACITY WITHDRAWALS

Completed	Mill	Capacity (short tpy)	Date
Gulf States Paper	Tuscaloosa, Ala.	167,000	1978
Crown Zellerbach	Bogalusa, La.	140,000	1979
Boise Southern	Elizabeth, La.	105,000	1981
Manville Forest	West Monroe, La.	35,000	1981
St. Regis	Lufkin, Texas	100,000	1981
Georgia-Pacific	Crossett, Ark.	175,000	1984-85
	Monticello, Miss.	158,000	1985
International Paper	Mobile, Ala.	135,000	1985
Champion International	Pensacola, Fla.	236,000	1986
Gilman Paper	St. Marys, Ga.	86,000	1988
Total withdrawals		**1,337,000**	

packaging grades has been good, but a number of mills that produce them have been victims of weak markets and high raw material costs.

James River Corp. was formerly the major producer of these grades, but in 1990 the company announced a major divestment program involving some 30 mills and converting plants representing $1.3 billion in sales. James River's specialty papers business was the primary target of the restructuring plan. James River sold a number of its specialty mills to a new company, Specialty Coatings Group Inc., which was formed by senior managers and AEA Investors Inc. Other leading producers of specialty papers include P.H. Glatfelter Co., Mosinee Paper Corp., CPM Inc., Wausau Paper Mills Co., Filtration Sciences Corp., Hollingsworth & Vose Co., and Dexter Corp.

In the specialty packaging and industrial paper sector, James River expanded significantly during the past decade by acquiring several small, nonintegrated specialty paper companies, including Riegel Products Corp. (1977), Brown Co. (1980), Premoid Corp. (1986), Specialty Paper Co. (1986), and Dunn Paper Co. (1987). James River also acquired specialty converting plants from H.P. Smith Paper Co. (1983) and Crown Zellerbach Corp. (1986).

Meanwhile, other companies sold or shut down their specialty paper businesses, including Bemis Corp. (1977-86), Port Huron Paper Corp. (1983), and Philip Morris Inc. (1985). Thilmany Pulp & Paper Co. shut down two of its specialty paper machines in 1987.

In contrast to this trend, Longview Fibre and Consolidated Papers Inc. added new paper machine capacity for lightweight specialty packaging papers in 1990. Markets for these grades have been very good in recent years as a result of strong demand for specialty and flexible packaging as well as labeling.

SUPPLY/DEMAND TRENDS

Production of packaging and industrial converting papers has gradually declined over the past ten years. During the period 1980-90, industry shipments decreased from 5.5 million tons annually to 5.0 million tons. This resulted in a negative annual growth rate of about -1.0% during the period, compared with a 2.4% annual growth rate for all grades of paper and paperboard.

Most of the decline was in unbleached kraft grocery bag and sack paper grades, which have been displaced by plastic bags in a majority of the nation's supermarkets. Multiwall shipping sack papers have also lost market share to plastics. Bleached packaging papers had remained strong until 1990, when McDonald's Corp. decided to convert all

U.S. PRODUCTION AND CAPACITY OF PACKAGING AND INDUSTRIAL CONVERTING PAPER BY GRADES

(000 short tons)

	Unbleached kraft		Bleached kraft*		Special industrial paper	
Year	Production	Capacity	Production	Capacity	Production	Capacity
1990	2,377	2,795	1,047	1,175	1,153	1,496
1989	2,681	2,809	988	1,155	1,248	1,471
1988	2,800	2,908	1,022	1,077	1,211	1,417
1987r	2,839	3,295	952	1,025	1,182	1,131
1986r	3,116	3,579	946	1,028	1,086	1,086
1985r	3,246	3,808	941	1,045	1,043	1,074
1984r	3,520	3,972	955	1,038	1,092	968
1983r	3,505	4,065	937	1,157	1,040	894
1982r	3,413	4,091	822	1,068	957	906
1981r	3,569	3,961	828	975	854	870
1980r	3,653	4,110	876	1,095	523	850
1979	4,096	4,098	993	1,105	531	883
1978	3,998	4,223	1,043	1,041	498	856
1977	3,936	4,317	1,002	1,069	524	856
1976	3,918	4,218	1,138	1,128	574	856
1975	3,374	4,333	965	1,194	440	841
1974	4,169	4,389	1,205	1,291	598	679
1973	3,902	4,138	1,205	1,292	610	629
1972	3,811	4,083	1,272	1,323	507	622
1971	3,649	4,031	1,242	1,383	438	549
1970	3,786	4,007	1,231	1,316	421	554
1969	3,780	4,006	1,297	1,275	443	559

*Includes glassine, greaseproof, and vegetable parchment.
r = Revised.
Sources: American Paper Institute.

of its carryout bags to 100% recycled paper by the middle of 1991. Bleached bag paper production dropped about 15% in 1991 as a result of the substitution of recycled bag paper by McDonald's and other fast-food chains.

Although kraft packaging and industrial paper production declined throughout the 1980s, operating rates remained close to 90% because of planned capacity reductions. Most of the decline in capacity was concentrated in the unbleached kraft segment of the industry. This trend is expected to continue but at a slower pace than in recent years. Unfortunately, capacity withdrawals have not kept pace with declining shipments in 1990-91; therefore, operating rates have dropped to about 80%.

KRAFT PACKAGING PAPERS

U.S. unbleached kraft paper shipments peaked at almost 4.2 million tons in 1974 and then plummeted to 2.3 million tons by 1990. Most of the decline occurred during the period of 1984-87, when shipments decreased nearly 680,000 tons. Grocery bag and sack grades suffered heavy losses, while multiwall sack grades had smaller losses.

In contrast, shipments of bleached and specialty packaging papers in the early 1980s declined slightly but then rebounded in 1987-90. In 1990, bleached kraft paper shipments reached 484,000 tons and specialty packaging grades climbed to 563,000 tons, for a total of about 1.1 million tons. This total is approximately equal to the 1978 level of industry shipments.

In 1989, the American Paper Institute (API) reclassified 275,000 tons of unbleached kraft paper and 75,000 tons of bleached kraft paper capacity as specialty grades. The transfer did not affect the industry's total level of production, but it did establish lower 1988 output levels for unbleached kraft papers (2.800 million tons) and bleached kraft papers (465,000 tons).

Shipments of unbleached kraft paper grades in 1991 are expected to be down about 3% to 4% because of continued weakness in multiwall markets and continued competition from plastics. Although the long-term decline in grocery

ESTIMATED CAPACITY OF U.S. COMPANIES PRODUCING PACKAGING AND SPECIALTY PAPERS

Company	Annual capacity (000 short tons)	Grades
1. Stone Container[1]	576	Unbleached bag, sack, and converting
2. Longview Fibre	500	Unbleached and bleached bag, sack, and converting
3. Georgia-Pacific	365	Unbleached and bleached bag, sack, and converting
4. International Paper	350	Unbleached and bleached bag, sack, and converting
5. Union Camp	300	Unbleached and bleached bag, sack, and converting and saturating kraft
6. Gaylord/Mid-America	270	Unbleached bag, sack, and converting
7. Gilman Paper	230	Unbleached and bleached bag, sack, and converting
8. Westvaco	200	Saturating kraft
9. Champion International	195	Unbleached and bleached bag, sack, and converting
10. Ivex[2]	160	Specialty and industrial
11. Wausau Paper Mills[3]	150	Glassine, greaseproof, and specialty
12. Specialty Coatings Group[4]	138	Specialty packaging and industrial
13. Mosinee Paper	120	Specialty and industrial
14. Chesapeake	115	Unbleached bag, sack, and converting
15. Kimberly-Clark	115	Cigarette paper, specialty, and saturating kraft
16. Consolidated Papers	110	Specialty packaging
17. Port Townsend	100	Unbleached bag, sack, and converting
18. P.H. Glatfelter[5]	90	Cigarette paper and technical specialty
19. Hammermill[6]	85	Specialty and industrial
20. James River	80	Specialty packaging
21. Simpson Tacoma Kraft	80	Unbleached and bleached bag, sack, and converting
22. Willamette Industries	70	Unbleached bag, sack, and converting
23. Hollingsworth & Vose	50	Specialty and industrial
24. CPM	30	Specialty and industrial
25. Filtration Sciences	30	Specialty and industrial
26. Burrows	30	Specialty packaging
27. Rolland-Fitchburg Paper[7]	30	Specialty and decorative
28. Schoeller Technical	30	Photographic and technical specialty
29. Mead Specialty Paper	25	Technical specialty

Note: Exact capacities for packaging papers are difficult to estimate because of swing machines in the industry, which can produce either linerboard or unbleached kraft packaging paper.

Estimates for specialty and industrial papers are based on published sources and may not include some printing/writing paper, thin paper, or tissue tonnage.

1. Includes Seminole Kraft Corp.
2. Ivex Corp. acquired Detroit River Paper Co. in 1990.
3. Includes Rhinelander Paper Co. but not Brokaw mill.
4. Acquired former James River specialty mills in 1991. Includes two U.K. mills.
5. Includes Ecusta Corp.
6. Includes Thilmany Paper Co. and Nicolet Paper Co.
7. Subsidiary of Rolland Inc. (Canada).

bag and sack was expected to have bottomed out in 1990, it appears that losses will continue through at least 1991.

Shipments of bleached packaging grades, which were rising in 1989 and 1990, are expected to fall by 15% in 1991. Specialty grades should show 8% to 10% growth in 1991 because of additional output from new machines at Longview Fibre and Consolidated Papers.

Recycled bag and sack papers will show the highest growth rate in this segment of the industry. Shipments of recycled bag and sack grades have surged in the past two years. From a base of under 50,000 tons in 1989, shipments have increased to approximately 160,000 tons in 1990 and an estimated 190,000 tons in 1991. Recycled grades now account for 8% to 10% of all unbleached paper shipments. Among the companies producing recycled grades are Stone Container, Longview Fibre, Menominee Paper Co., Keiffer Paper Mills, Ivex Corp., and Norfolk Paper Co.

Grocery bag and sack paper. The single largest end-use market for unbleached kraft papers is grocery bag and sack paper. Production grew steadily during the first two decades after World War II due to the rapid growth of supermarket chains and the increased demand for large carryout sacks. By the 1970s, however, shipments of grocery bag and sack began leveling off as population growth rates flattened and as plastic bags began displacing kraft paper. The introduction of plastic grocery bags signaled the end of kraft paper's dominance of the carryout sack market.

Plastic's share of the grocery sack market rose from about 2% in 1976 to about 30% in 1987, and it has increased to an estimated 70% to 75% of the market in 1991. Paper sacks lost market share simply because plastic sacks became more cost-competitive as producers succeeded in down-gauging their films, thereby reducing raw material costs. In 1976, a plastic sack sold for the equivalent of 110% of the price of a paper sack. By 1980, the two products were at parity, and by 1987, the price of a plastic sack was 60% that of a paper sack.

The price gap between paper and plastic remains wide. In 1991, heavyweight paper grocery sacks sold for about $40/thousand, compared with about $20/thousand for plastic grocery sacks.

Competition between paper and plastic grocery sacks has had little dampening effect on kraft paper prices because prices for grocery sack paper are influenced more by linerboard prices than by plastic bag prices. Since some swing machines in the industry can manufacture either heavyweight grocery sack paper or lightweight linerboard, producers allocate machine time according to which grade gives them a better return.

A 1988 industry survey found that an average of 70,000

U.S. PRODUCTION OF PACKAGING AND INDUSTRIAL CONVERTING PAPER—BY END USE[1]

(000 short tons)

	Wrapping paper			Shipping sack paper			Bag and other paper			Other converting		
Year	Total	Unbleached	Other[2]	Total	Unbleached	Other[2]	Total	Unbleached	Other[2]	Total	Unbleached	Other[2]
1989	125	97	28	874	772	102	1,913	1,658	255	472	302	170
1988	105	81	24	973	863	110	1,946	1,684	262	594	479	115
1987	112	88	24	883	785	98	2,023	1,769	254	538	431	107
1986	117	93	24	831	747	84	2,314	2,050	264	526	412	114
1985	124	93	31	876	796	80	2,386	2,120	266	576	398	178
1984	135	97	38	968	878	90	2,543	2,284	259	591	405	186
1983	147	101	46	967	879	88	2,529	2,289	240	606	397	209
1982	138	93	45	973	895	78	2,433	2,211	222	547	364	183
1981	183	103	80	1,085	967	118	2,188	2,012	176	516	340	176
1980	240	137	103	1,154	1,062	92	2,330	2,101	229	670	419	251
1979	306	187	119	1,212	1,110	102	2,365	2,115	250	786	499	287
1978	365	210	155	1,111	1,019	92	2,365	2,092	273	815	551	264
1977	354	218	136	1,180	1,073	107	2,516	2,212	304	794	558	236
1976	321	195	126	1,228	1,100	128	2,428	2,154	274	902	499	403
1975	280	165	115	974	879	95	2,166	1,938	228	752	417	335
1974	369	226	143	1,409	1,279	130	2,134	1,889	245	980	535	445
1973	425	267	158	1,176	1,072	104	2,196	1,942	254	1,057	599	458
1972	498	294	204	1,101	996	105	2,183	1,942	241	1,142	694	448
1971	491	285	206	1,078	976	102	2,146	1,911	235	1,084	591	493
1970	518	298	220	1,094	996	98	2,117	1,898	219	1,088	596	492
1969	574	345	229	1,123	1,023	100	2,018	1,791	227	1,146	621	525

1. Excludes glassine, greaseproof, and parchment papers and specialty industrial papers.
2. Principally bleached kraft papers.

Source: Bureau of the Census (1981-89 based on shipments; prior years are for production). Data no longer available annually after 1989.

tons of kraft paper was produced on swing machines each month, representing about 30% of total kraft paper production. For the same period, an average of 232,000 tons of linerboard was produced on swing machines each month, representing about 13% of industry production. Since 1988, the amount of kraft paper produced on swing machines has fluctuated with market conditions, but the trend is similar.

Most of these swing machines make a better return when they produce lightweight linerboard during a rising linerboard market. This is because unit production costs are lower for 26-lb linerboard than for 70-lb kraft paper, and kraft paper prices must therefore remain competitive with linerboard prices to maximize mill profits. Also, some vertically integrated companies with converting operations in different regions of the country trade linerboard and kraft paper in lieu of actual market transactions. Therefore, the "trading" prices of kraft paper and linerboard are linked.

As a result, the price of 70-lb grocery sack paper increased about 18% in 1986 and 16% in 1987, while 26-lb linerboard prices increased about 18% in 1986 and 34% in 1987. In 1988, prices of 70-lb grocery sack paper reached the $455 to $465/ton level in the second quarter. They climbed to between $495 and $505/ton in early 1989 and remained at that level through most of 1990. In 1991, however, heavyweight kraft paper prices plummeted to $425 to $435/ton as linerboard output and prices collapsed.

Plastics will continue to grow at the expense of paper in

U.S. EXPORT AND IMPORT TRENDS FOR PACKAGING AND INDUSTRIAL CONVERTING PAPERS

(000 short tons)

Year	Exports[1]	Imports
1990	284	426
1989	342	407
1988	347	343
1987	294	310
1986	284	243
1985	244	172
1984	284	145
1983	261	108
1982	263	80
1981	303	94
1980	331	86
1979	227	143
1978	173	138
1976	356	56
1974	340	142
1972	183	148
1970	188	64

1. Includes unbleached kraft, special industrial paper and glassine, greaseproof, and parchment.
Sources: American Paper Institute, Bureau of the Census.

U.S. PRODUCTION OF UNBLEACHED KRAFT PACKAGING AND INDUSTRIAL CONVERTING PAPERS

(000 short tons)

				Bag and sack[2]			Other converting[3]				
Year	Total	Wrapping[1]	Shipping sack	Total	Grocer	Other	Total	Asphalting	Other creping	Gumming	Other
1989	2,958	90	775	1,658	1,595	63	435	—	—	—	—
1988	3,107	81	863	1,684	1,610	74	479	—	—	—	—
1987	3,073	88	785	1,769	1,690	79	431	—	—	—	—
1986	3,302	93	747	2,050	1,960	90	412	—	—	—	—
1985	3,403	93	797	2,116	2,043	73	397	—	—	—	—
1984	3,683	97	883	2,292	2,203	89	411	—	—	—	—
1983	3,666	100	879	2,289	2,196	93	398	—	—	—	—
1982	3,563	93	895	2,211	2,127	84	364	—	—	—	—
1981	3,729	103	1,015	2,209	2,117	92	402	—	—	—	—
1980	3,852	137	1,062	2,269	2,168	101	384	176	40	63	105
1979	3,984	187	1,110	2,226	2,120	106	461	215	25	80	141
1978	3,900	211	1,019	2,225	2,121	104	445	173	22	61	189
1977	3,916	218	1,073	2,100	1,994	106	525	179	14	66	266
1976	3,815	195	1,100	2,106	1,966	140	414	167	6	68	173
1975	3,322	165	879	1,925	1,805	120	353	131	6	61	155
1974	4,079	226	1,279	2,131	1,974	156	443	134	13	83	213
1973	3,771	266	1,072	1,942	1,825	117	491	150	17	90	234
1972	3,825	294	996	1,942	1,854	88	593	165	25	96	307

1. All colored or natural brown MF and MG, including treated and untreated butcher papers.
2. Other than shipping sacks.
3. Data not available or withheld for 1981-89.
Sources: Bureau of the Census, American Paper Institute. Data no longer available annually after 1989.

the grocery sack market, but the penetration rate will slow. Plastics has reached 70% to 75% of the supermarkets in the U.S. and may soon reach its maximum market share.

Shipping sacks. The second largest end use for unbleached kraft paper after grocery bags and sacks is shipping sacks. Shipments peaked at slightly more than 1.0 million tons annually in the late 1970s and have declined since then. Shipments averaged about 880,000 tpy in the 1982-84 period and plummeted to 747,000 tons in 1986. Shipments rebounded in 1987 and 1988 but fell again in 1989-90.

Shipments of bleached multiwall sack paper climbed from 98,000 tons in 1987 to 110,000 tons in 1988 and then slipped to 102,000 tons in 1989. Total multiwall paper shipments were expected to drop off again in 1990-91 because of weaker demand for shipping sacks from agricultural, chemical, and construction industries. In contrast to these commodity markets, demand for multiwall bags for consumer flexible packaging has remained strong.

U.S. PRICE TRENDS FOR SELECTED UNBLEACHED KRAFT PAPER GRADES

($/short ton)

Year[1]	Shipping sack +50-lb	Grocery sack +70-lb	Grocery bag and sack +30-lb
1991			
3Q	$550	$425/435	$630/660
2Q	550	425/435	630/660
1Q	550	445/455	630/660
1990			
4Q	550	465/475	630/660
3Q	550	495/500	630/660
2Q	550	495/500	630/660
1Q	550	495/500	630/660
1989			
4Q	550	495/500	630/660
3Q	550/560	495/505	645/665
2Q	550/560	495/505	645/665
1Q	550/560	495/505	660/680
1988			
4Q	510/520	455/465	620/640
3Q	510/520	455/465	620/640
2Q	510/520	455/465	620/640
1Q	510/520	455/465	620/640
1987	470	415	580
1986	390	335/345	535
1985	375	288	441
1984	415	336	502
1983	395	250	—
1982	381	260	—
1981	401	305	—
1980	371	272	—
1979	328	243	—
1978	296	220	—
1977	288	199	—
1976	271	209	—
1975	266	220	—
1974	220	199	—

1. Annual average showed for years 1974 to 1987.
Source: *Pulp & Paper Week*.

Multiwall paper shipments were up sharply in 1987 and 1988 because of strength in the commodity industries, where multiwall sacks are used for shipping fertilizer, animal feed, seed, cement, plastic resins, and other materials. The major competitive threat to shipping sacks is from bulk handling and heavy-duty plastic shipping sacks, which have made steady market penetration. Many multiwall sacks, however, are made with a barrier layer of polyethylene film for moisture resistance and added strength.

A more significant reason for the decline in multiwall paper tonnage since 1981 is the reduction in the weight of paper used in multiwall sacks. The four basic weights of kraft paper—40, 50, 60, and 70 lb—have different tear and tensile strengths. As a general rule, greater weight means greater strength. But tear and tensile properties of kraft paper can be increased in the papermaking process, permitting substitution of lighter-weight paper. For example, during the drying process, the MD strength of kraft paper can be substantially increased. As previously mentioned, this extensible type of kraft paper can absorb more shock without rupturing than can conventional kraft paper. The process for manufacturing extensible kraft paper was commercially developed in the late 1950s by Clupak Inc. of New York. Clupak is the leading licensor of extensible kraft paper technology throughout the world.

In 1982, St. Regis Paper Co. introduced a rival air-dried multiwall kraft paper with greater strength and stretch. St. Regis's Stress Kraft paper permitted sack converters to eliminate a ply of paper for a basis-weight reduction of at least 18%, yet it performed as well as regular sack paper. Nevertheless, converters were unwilling to pay a premium price for Stress Kraft, and orders dried up during the 1982 recession. Following Champion International's takeover of St. Regis in 1984, production of Stress Kraft at St. Regis's Pensacola, Fla., mill was phased out.

Prices for 50-lb multiwall kraft paper increased about 11% in 1986 and 14% in 1987. During second-quarter 1988, they reached $510 to $520/ton. In 1989, prices climbed to between $550 and $560/ton, and they have remained near the $550/ton level during 1990-91. Bleached multiwall paper sells for about $710/ton. Prices for clay-coated papers are somewhat higher. The price of 50-lb clay-coated bleached multiwall paper used in high-quality printed bags was about $1,240 to $1,280/ton in 1989.

Other bag and sack paper. These papers are used mainly for retail and carryout bags used by department stores, fast-food restaurants, bakeries, etc. This market has been affected by plastic retail bags and, more recently, by 100% recycled paper bags. In 1990, McDonald's introduced Stone Container's Good News White bag made from 70% recycled old newspapers, and the fast-food business has not been the same since. McDonald's also uses unbleached carryout bags made from 100% recycled corrugated containers and kraft bag clippings.

Paper garment bags were largely displaced by plastics in the 1960s, and merchandise bags met heavy competition from plastics in the 1970s. With the introduction of low-cost plastic merchandise bags, plastics captured an estimated 75% of the retail clothing market. However, a consumer backlash has recently developed against plastic bags that are not biodegradable or recyclable.

Upscale department stores typically use heavier-weight, decorative paper merchandise bags to convey a quality image, and retail food stores often use lighter-weight, bleached coated paper bags for their sanitary appearance. These papers are often machine finished and machine glazed to impart gloss or special barrier properties to the paper. Production of these grades has remained steady because of continued demand from certain niche markets.

In 1990-91, lightweight 30-lb unbleached kraft bag paper sold for about $660/ton in the U.S. Lightweight 30-lb bleached kraft bag paper sold for $800 to $810/ton in 1990-91. MF and MG papers demanded slightly higher prices.

Wrapping paper. Much of wrapping paper's market share also has been lost to plastic stretch and shrink films. However, the paper converting industry remains one of the largest users of wrapping papers for paper rolls and cut-size sheets of paper. Shipments of unbleached and bleached wrapping papers total about 100,000 tons annually. For the short term, demand is expected to increase with total paper shipments. Unbleached grades are used mostly for paper roll wraps as well as for mail room and parcel post wraps. The bleached grades are widely used for cut-size papers. Thilmany, a division of International Paper, is one of the largest producers of both bleached and natural kraft wrapping papers.

SPECIALTY PACKAGING PAPERS

Specialty packaging papers, both unbleached and bleached, have shown good growth in recent years. Total shipments increased from 520,000 tons in 1989 to 563,000 tons in 1990. Shipments are forecast to reach 600,000 tons in 1991. Specialty grades are usually coated, waxed, or gummed for use as food wraps, packaging labels, and laminated papers, among other applications. Although demand

U.S. PRODUCTION OF MAINLY BLEACHED PACKAGING AND INDUSTRIAL CONVERTING PAPERS[1]

(000 short tons)

			Shipping sack[3]			Other bag and sack			Other converting[4]		
Year	Total[1]	Wrapping[2]	Total	Sulfite kraft	Other	Total	Grocer	Other	Total	Waxing	Other[5]
1989	636	48	184	174	10	234	169	65	170	110	60
1988	674	46	190	182	8	242	172	70	196	128	68
1987	663	46	178	168	10	214	153	61	225	147	78
1986	616	33	173	162	11	204	142	63	205	148	57
1985	570	33	118	107	11	240	170	70	178	130	48
1984	555	50	113	92	21	209	137	72	183	132	51
1983	561	65	119	95	24	168	122	46	209	157	52
1982	497	66	105	—	—	143	105	38	183	136	47
1981	536	80	117	84	34	176	124	51	167	120	47
1980	574	103	92	—	—	229	155	73	150	98	52
1979	643	119	102	—	—	250	170	80	172	113	59
1978	711	155	92	—	—	273	217	55	191	76	115
1977	716	136	107	—	—	304	198	106	169	69	100
1976	852	126	128	29	99	274	153	121	324	117	207
1975	629	115	95	27	68	228	133	95	191	97	94
1974	774	143	130	39	91	245	144	101	256	117	139
1973	786	158	104	22	82	254	169	85	270	138	132
1972	849	204	115	23	92	241	168	73	289	141	148

1. Excluding unbleached, glassine, greaseproof, and parchment papers. Principally bleached kraft paper, but can include sulfite and other-fiber-based papers.
2. Includes MG and MF wrapping papers and miscellaneous. MG/MF includes treated and untreated butcher papers.
MG/MF production: 1980, 95; 1979, 109; 1978, 127; 1977, 122; 1976, 109; 1975, 100; 1974, 121; 1973, 133; 1972, 171.
Miscellaneous production: 1980, 8; 1979, 10; 1978, 28; 1977, 15; 1976, 17; 1975, 15; 1974, 22; 1973, 25; 1972, 33.
3. Includes combination kraft and rope, bleached and semibleached.
4. Over 18 lb. Production figures available in earlier years:
Envelope stock: 1976, 130; 1975, 99; 1974, 135; 1973, 130; 1972, 126.
Gumming stock: 1980, 32; 1979, 34; 1978, 23; 1977, 14; 1976, 12; 1975, 10; 1974, 11; 1973, 13; 1972, 13.
Twisting/spinning stock: 1974, 34; 1973, 35; 1972, 48.
5. Such as asphalting, creping stock, etc.
Sources: Bureau of the Census, *Pulp & Paper* estimates. Data no longer available annually after 1989.

for these papers declined in the 1970s as plastics claimed a large share of the flexible packaging market, the erosion has slackened in recent years. Specialty grades that are in direct competition with plastic barrier films in consumer food packaging will generally continue to lose share gradually, but demand from other niche markets will support growth in specialty papers.

For example, James River introduced a new Quilt-Rap laminated paper wrap for the fast-food industry in 1990, and McDonald's is now using it as a replacement for foam clamshell containers in all of its U.S. restaurants. Burrows Paper Corp. of Little Falls, N.Y., which is the leading manufacturer and converter of specialty wraps for the fast-food industry, reported a 12% sales gain in 1990 based on increased demand for its products. Specialty wraps that offer grease resistance, heat retention, and moisture barrier properties can be a cost-effective alternative to plastic wraps or foam containers.

Consolidated Papers' mill at Stevens Point, Wis., is among the largest U.S. producers of lightweight coated specialty grades used in flexible packaging and printed labels. In late 1990, Consolidated completed a $135-million paper machine expansion project and started up a new machine from Sulzer Escher Wyss with capacity to produce 160 tpd of specialty papers, or 59,000 tpy. This expansion will double the mill's total capacity to produce specialty grades.

Longview Fibre also started up a new kraft paper machine at its Longview, Wash,. mill in 1990. Longview's new Beloit fourdrinier machine cost about $90 million to install and has capacity to produce 300 tpd, or 110,000 tpy. The machine will produce both bleached and unbleached lightweight specialty grades and bag paper.

GLASSINE/VEGETABLE PARCHMENT/CELLOPHANE

These grades are a unique part of the specialty papers segment of the industry. Cellophane was widely used as an outer wrapping for cigarette packaging before the development of lightweight, transparent plastic films. Like cellophane, glassine papers have smooth, glass-like surfaces and are transparent. They are used mostly for protective food and nonfood packaging, but other applications include drafting and graphic papers and envelope windows. Glassine typically is produced from sulfite pulp.

In the glassine process, sulfite pulp is beaten and refined to such a high degree that the pulp appears to be a dense, gelatinous mass. The high degree of fiber damage and collapse that occurs during pulping increases the fiber bonding area and makes glassine highly resistant to the passage of vapors, oils, and grease. When waxed, lacquered, or laminated, the paper is also impervious to moisture. Glassine is formed on a fourdrinier paper machine and is supercalendered to give the sheet a high gloss. Typical basis weights range from 15 to 40 lb (24 x 36 in., 500 sheets).

Vegetable parchment gets its name from its resemblance to animal parchment. It is prepared by passing a sheet of cotton-fiber or chemical-wood-pulp paper through a bath of sulfuric acid, followed by washing and drying. The resulting sheet has a parchment texture and appearance. It is very durable and resistant to grease and other contaminants. The sheet has high wet strength, and it may be waxed, coated, embossed, or crinkled. As a printing paper, it is a high-quality sheet used for legal documents. Basis weights range from 24 to 40 lb (17 x 22 in., 500 sheets).

For packaging applications, both vegetable parchment and greaseproof papers have various weights and degrees of translucency or opaqueness. They are used to wrap frozen, moist, greasy, or dry food products, such as butter, meat, and poultry. Like cellophane

PRODUCERS OF VEGETABLE PARCHMENT, GLASSINE, AND GREASEPROOF PAPERS

Company	Location	Grades	Capacity[1] (tpd)
1. James River			
Riegel Products Div.	Milford, N.J.	Glassine, greaseproof	100
KVP/Dunn Paper Div.	Parchment, Mich.	Vegetable parchment	120
2. Wausau Paper Mills			
Rhinelander Paper	Rhinelander, Wis.	Glassine, greaseproof	150
3. Hammermill Paper			
Nicolet Paper	De Pere, Wis.	Glassine, greaseproof	140
4. E.B. Eddy Forest Products	Espanola, Ont.	Vegetable parchment, greaseproof	140
5. Flexel	Atlanta, Ga.	Cellophane	114
6. Simkins Industries			
Westfield River Paper	Lee, Mass.	Glassine, greaseproof	15
	Russell, Mass.	Glassine, greaseproof	50
Deerfield Specialty	Nixon, Ga.	Glassine, greaseproof	55
	Quebec, Que.[2]	Glassine, greaseproof	35
7. Domtar	St. Catherines, Ont.	Glassine, greaseproof, vegetable parchment	70

1. Capacity estimates may include tonnage of other specialty grades.
2. Subsidiary is Glassine Canada Inc.

and waxed papers, they have lost many of their traditional markets to plastic films. In 1980, production of these papers was reported by the Bureau of the Census to be about 200,000 tons. The figure may be half of that today. James River, Nicolet Paper Co., and Simkins Industries Inc. in the U.S. and E.B. Eddy Forest Products Ltd. in Canada are the industry's principal producers of these grades. Flexel Inc. of Atlanta, Ga., is the only U.S. producer of cellophane.

SPECIALTY INDUSTRIAL PAPERS

Specialty industrial papers represent a unique segment of the paper industry. More than 300 different specialty papers are produced for customers in the U.S. and abroad. These papers are generally used by industry for conversion into other products and require the blending of various fibers and chemicals and special surface treatment or lamination with synthetic films, textiles, or other materials. Industrial papers are produced to exact customer specifications, and they are used in the manufacture of automotive and industrial filter papers, cigarette papers, photographic basepapers, sanding belts and other abrasives, masking tapes, engine gaskets, electrical insulators, and pressure-sensitive release papers.

Production of specialty industrial papers has increased gradually since 1970 and currently totals slightly over 1.1 million tons, according to API. However, because it is difficult to define these grades and to separate them from other converting grades, published capacity and production figures are not good indicators of industry trends. Some types of industrial papers have lost market share, especially in areas where plastic and synthetic products can substitute, such as nonwovens. Nonetheless, overall demand for specialty industrial grades remains good, with pressure-sensitive release papers and filter papers performing best. As a result, pricing for most specialty grades remains strong. Some specialty paper sells for as high as $8/lb (or $16,000/ton) in the U.S.

Specialty papers are typically produced by small, privately held companies or divisions of larger paper companies. Mills producing industrial specialties usually have capacities ranging from 12 to 50 tpd. Most of these mills purchase pulp from outside sources and may need as many as ten to 20 different types of woodpulp, glass fibers, hemp fibers, and other materials to produce specialty papers. A mill often produces up to eight different grades of specialty paper/day on older machines with widths of 15 ft or less.

James River was formerly the major North American producer of specialty industrial papers. A large part of James River's specialty industrial business, including the H.P. Smith operations, was sold to Specialty Coatings Group Inc. in 1991. H.P. Smith is the largest independent manufacturer of polyethylene coated and silicone coated

U.S. PRODUCTION, EXPORTS, AND IMPORTS OF PARCHMENT, GREASEPROOF PAPERS, AND GLASSINE

(000 short tons)

Year	Production	Exports	Imports
1988	—	32	24
1987	—	6	23
1986	—	4	17
1985	—	6	16
1984	—	5	12
1983	209	17	8
1982	206	5	6
1981	176	9	5
1980	202	8	4
1979	234	8	5
1978	259	8	5
1977	219	5	3
1976	207	10	3
1975	191	11	2
1974	240	8	3
1973	230	4	3
1972	234	3	2
1971	206	3	2
1970	203	3	3
1969	216	—	—

Source: Bureau of the Census.

CANADIAN PRODUCTION AND CAPACITY FOR KRAFT PAPERS

(000 metric tons)

Year	Production	Capacity	Utilization rate (%)
1990	497	508	97.8%
1989	525	512	102.5
1988	568	560	101.4
1987	567	579	97.9
1986	540	579	93.3
1985	486	541	89.8
1984	430	531	81.0
1983	475	554	85.7
1982	453	527	86.0
1981	516	566	91.2
1980	538	562	95.7
1979	606	617	98.2
1978	637	622	102.4
1977	546	621	87.9
1976	518	624	83.0
1975	422	641	65.8
1974	637	636	100.2
1973	616	602	102.3
1972	537	570	94.2
1971	492	—	—
1970	439	—	—
1969	451	—	—

Source: Canadian Pulp & Paper Assn.

paper and film release liners for pressure-sensitive labels and self-adhesive papers and films. Other notable producers include Filtration Sciences, C.H. Dexter, Mosinee Paper, Hollingsworth & Vose, Wausau Paper Mills, P.H. Glatfelter, CPM Inc., and Thilmany Paper. In 1989, European specialty papermaker A. Ahlstrom Corp. acquired Filtration Sciences, the leading U.S. manufacturer of automotive filter papers.

Specialty decorative laminating papers are a unique, growing segment of the specialty industrial area. These papers are combined with either particleboard or saturating kraft paper to produce laminates for kitchen countertops, office furniture, or construction grades. The decor papers are produced by the specialty paper divisions of Mead Corp., Rolland Inc., and Sorg Paper Co. Industry capacity of decor papers is estimated at about 60,000 tons.

The major producers of saturating kraft papers are Westvaco Corp., Charleston, S.C.; Union Camp, Savannah, Ga.; and Simpson Tacoma Kraft Co., Tacoma, Wash. In 1984, Union Camp completed a $27-million improvement on its saturating kraft paper machine, and in 1987, Westvaco rebuilt a saturating kraft paper machine to increase capacity. In 1989, Simpson installed the world's largest converting unit for impregnating kraft papers with phenolic resins. Ivex also produces waterproof saturated papers at its Joliet, Ill., mill. Industry capacity of saturating kraft papers is estimated at about 350,000 tons.

CANADIAN KRAFT PAPER INDUSTRY

The Canadian kraft paper industry faces many of the same market conditions for its products as the U.S. industry. Domestic kraft paper consumption has gradually declined as plastic products have replaced paper bags and sacks in traditional end-use markets. However, Canadian producers have offset these losses by increasing their export shipments of kraft paper to the U.S. and overseas markets, particularly for high-strength shipping sack grades.

Production of bleached and unbleached kraft papers gradually declined from a cyclical peak of 637,000 metric tons in 1978 to 430,000 tons in 1984. By 1988, production had rebounded to 568,000 tons, but it slipped to 525,000 tons in 1989. In 1990, production slipped again to 497,000 tons due to weak markets for shipping sack papers. As shipments declined during the past decade, producers withdrew capacity from the market, and as a result, industry operating rates have actually remained high.

The decline in domestic consumption of kraft papers has affected mostly eastern Canadian mills, which were built to serve the domestic market and are not particularly cost-competitive. Companies that have dropped out of the kraft paper business were concentrated in the East and include Great Lakes Forest Products Ltd., CIP Inc., Abitibi-Price Inc., and Consolidated-Bathhurst Inc. The western Canadian industry, on the other hand, is highly export-oriented and includes large, efficient mills operated by Canfor Corp., Eurocan Pulp & Paper Co. Ltd., and Manfor Ltd. All of these companies constructed new greenfield mills during the last decade, and each mill had a capacity in excess of 100,000 metric tpy.

In 1989, the most significant development in this sector was the sale of Manfor Ltd., formerly owned by the Manitoba government, to Repap Enterprises Corp. Inc. Repap ultimately plans to convert the mill's production line from 400 metric tpd of high-strength kraft sack paper to 500 metric tpd of bleached kraft pulp. In a second stage, Repap will construct a new world-class, 1,200-metric-tpd softwood bleached kraft pulp mill at the facility. A deterioration in Repap's finances during the past year has raised serious questions about the financial feasibility of this project.

Domestic kraft paper shipments have declined from about 240,000 metric tpy to 160,000 tpy in the past four years. The loss is largely due to competition from plastic packaging. Plastics have captured about 60% of the Canadian grocery bag and sack market and about 40% of the shipping sack market. Although this market penetration is uneven throughout the country, it is generally conceded that market losses will continue, although at a slower rate.

Fortunately, Canadian producers have boosted their exports from 192,000 tons in 1984 to 325,000 tons in 1990. Approximately 50% of kraft paper exports are destined for the U.S. market, and nearly 100% of converted kraft paper bag and sack exports go to the U.S. Multiwall kraft paper and shipping sacks account for most of the export activity.

ESTIMATED CAPACITY OF CANADIAN COMPANIES FOR KRAFT AND SPECIALTY PAPERS

(000 metric tons)

Company	Annual capacity*	Grades
Repap Manitoba[1]	140	Unbleached bag, sack
Eurocan Pulp & Paper	130	Unbleached bag, sack, wrapping
Prince George Pulp & Paper[2]	110	Bleached and unbleached sack, bag
Cascades	80	Unbleached and bleached bag, wrapping
Fletcher Challenge Canada[3]	45	Bag, wrapping, converting
E.B. Eddy Forest Products	45	Bleached bag, sack, converting, wrapping
Domtar	30	Bleached and unbleached bag, sack, converting, wrapping
Fraser	8	Kraft wrapping and specialty paper
J. Ford & Co.	7	Kraft wrapping and specialty paper

*Consolidated-Bathurst shut down a 35,000-metric-tpy kraft paper machine in 1988.

[1] Formerly Manfor Corp.

[2] Subsidiary of Canadian Forest Products Ltd.

[3] Formerly Crown Forest Industries Ltd.

Paper:

TISSUE

The tissue market includes two major sectors: sanitary and "other." Sanitary products form the larger category and include bathroom and facial tissue, toweling, napkins, basestock for sanitary stock, wadding, and wipes. The "other" group accounts for just 2% of the market and includes basestock for waxing, wrapping, and miscellaneous uses.

The two major outlets for tissue are consumer and commercial and industrial (C&I). Consumer tissue accounts for nearly two-thirds of the market and is purchased at retail outlets. Industrial tissue goes to hotels, offices, restaurants, factories, and institutions. Consumer tissue growth is expected to be half that of commercial products over the next few years.

Producers in both the consumer and C&I sectors were chilled by the 1990-91 recession after many years of slow but steady growth. The weakening economy prompted consumers to use lower-priced and private-label tissue, hurting upscale products. In addition, the away-from-home market suffered some because of its ties to employment and traveling. Domestic tissue markets became more competitive as demand from retailers slowed and new products churned up the market. Earnings were pressured in first-half 1991, and some major projects were delayed or canceled.

Prices up. The producer price index for tissue rose 7% in 1990 and increased 1.3% in first-half 1991 vs first-half 1990. However, this index does not reflect the impact of promotions, which lower producers' realizations. In addition, tissue firms typically do not fully achieve announced price increases, according to Jeanne Carroll, analyst with Morgan Stanley & Co. Inc., and such increases tend not to move into place when the firms say they will.

Tissue producers' actual realizations crept up through most of 1990, resulting in an increase of about 3% in both the away-from-home sector and the consumer market by the end of the year—excluding bathroom tissue in the South, where Kimberly-Clark Corp. introduced its new Kleenex premium bath tissue in September 1990.

K-C's re-emergence into the premium consumer bath tissue business sparked a round of promotional activity among its competitors, forcing down product realizations. Premium consumer bath tissue transaction prices in the South dropped 20% below normal by spring 1991 and were down 8% to 10% in other regions, according to Morgan Stanley's Carroll. Realizations in other consumer tissue products were off just 1% to 2%. Lower-end commodity grades in the away-from-home market saw some price slippage after the third quarter, but the rest of the grades were holding up well in the first quarter, she added.

In spite of the languid economy, tissue producers continue to run at high operating rates. Tissue production and consumption both grew each year from 1983 to 1990. Production in 1990 reached 5.802 million tons, according to the American Paper Institute. Analysts expected production

U.S. STATISTICS FOR TISSUE*

	1991e	1990	1989
Production, 000 tons	5,860	5,802	5,636
Capacity[1]	6,113	5,976	5,798
Utilization rate, %	95.9	97.1	97.2
Imports[2]	120	131	121
Exports[2]	35	35	21
Apparent U.S. consumption	5,945	5,898	5,736
lb/capita	47.3	47.4	46.6
GNP ratio (000 tons/ billion $ real GNP)	1.43	1.42	1.38

*All tons are short tons.
e = Estimate.
1. American Paper Institute data.
2. U.S. Dept. of Commerce data.

would be in the range of 5.78 to 5.85 million tons in 1991. They estimated that 1990 capacity reached 5.97 million tons and operating rates stood at 96% to 97%; capacity was expected to grow to 6.11 to 6.16 million tons in 1991 for an operating rate of 95% to 96%.

With capacity utilization above 95%, the cutthroat competition spawned by the Kleenex bath tissue launch was bound to come to an end, and the industry eventually decided to shake the premium bathroom tissue sector free from excessive promotional activity. Market leader Procter & Gamble Co. led the charge by dropping list prices 9.8% on its single-ply Charmin and two-ply White Cloud brands, while reducing sheet count from 300 down to 280 on Charmin and from 250 down to 230 on White Cloud. The price drop went into effect in July 1991, and the sheet-count move began in August. Scott Paper Co., James River Corp., and Kimberly-Clark followed P&G's lead with varying combinations of price and sheet-count reductions.

It is unlikely the tissue makers will be able to carry sheet-count maneuvering much further. Consumers—who used to get 500 sheets on a roll a dozen years ago—might resist additional sheet-count reductions. And while dropping the sheet count offsets reductions in the list price, it does not lower costs proportionately because of higher handling, packaging, and transportation costs on a unit basis. On the other hand, when tissue manufacturers reduce the list price, they also generally reduce promotional programs by a similar amount. With K-C easing up and the economy improving, George Adler, analyst with Smith Barney, Harris Upham & Co., predicted prices and profits would pick up by the following spring. And Carroll said that on the whole, the U.S. tissue market will remain favorable over the next few years because of limited new supply and favorable pricing of raw material. Although a number of tissue projects were announced in 1990—including two James River machines at Naheola, Ala., and Old Town, Maine; two Procter & Gamble machines east of the Rockies; and a Scott recycled tissue mill in Kentucky—the only thing put through was the second P&G Oxnard, Calif., machine. Adler dismisses the other projects as posturing and

U.S. SHIPMENTS AND CAPACITY OF TISSUE PAPER

(000 short tons)

Year	Production[1]	Change (%)	Capacity[2]	Change (%)
1993p	—	—	6,349	1.8%
1992p	6,000	2.4%	6,235	2.0
1991p	5,860	1.0	6,113	2.3
1990	5,802	2.9	5,976	3.7
1989	5,636	2.9	5,762	1.7
1988	5,476	3.3	5,667	2.9
1987	5,301	4.0	5,505	0.6
1986	5,095	3.1	5,472	2.4
1985	4,941	0.4	5,345	1.3
1984	4,921	2.7	5,276	1.7
1983	4,792	7.9	5,190	1.3
1982	4,441	-1.7	5,125	1.8
1981	4,517	3.2	5,033	1.6
1980	4,375	-3.2	4,954	1.7
1979	4,521	7.3	4,870	4.8
1978	4,215	-1.6	4,644	2.1
1977	4,285	2.4	4,545	1.0
1976	4,184	5.2	4,500	1.5
1975	3,979	-2.6	4,432	2.5
1974	4,086	1.2	4,322	0.4
1973	4,039	1.6	4,303	-0.3
1972	3,977	3.8	4,318	1.7
1971	3,833	3.1	4,244	1.4
1970	3,718	3.0	4,185	8.1
1969	3,611	—	3,873	—
Average 1980-90		2.0		1.9

p = Preliminary.
1. Source: Bureau of the Census, analyst estimates.
2. Source: American Paper Institute.

CANADIAN PRODUCTION AND CAPACITY FOR TISSUE AND SANITARY PAPERS

(000 short tons)

Year	Production[1]	Capacity Sanitary papers	Capacity Other tissue
1993e	—	718	20
1992e	—	712	20
1991e	—	677	20
1990	514	635	20
1989	493	559	20
1988	494	548	20
1987	466	535	21
1986	495	516	20
1985	476	509	20
1984	424	514	20
1983	411	495	20
1982	413	500	21
1981	430	474	21
1980	406	414	23
1979	399	401	23
1978	368	403	24
1977	342	404	22
1976	335	385	25
1975	283	372	28
1974	361	353	27
1973	324	349	23
1972	312	344	20
1971	289	—	—
1970	240	—	—
1969	281	—	—

e = Estimate.
1. Excludes special papers.
Source: Canadian Pulp & Paper Assn.

said they are on the back burner.

Expansion update. Bathroom tissue is Kimberly-Clark's number one consumer product outside the U.S., but until recently the sector was allowed to languish domestically. With the new 68,000-tpy tissue mill in Jenks, Okla., however, the firm was able to re-enter the U.S. bathroom tissue market. The 100%-virgin-fiber tissue facility started up in April 1990.

Marketing efforts for the Jenks tissue were initially focused on the South. K-C expanded from there, and its eventual move into the Midwest gave it coverage of nearly half the country, sufficient to sell out Jenks' output, Adler said. The machine represents about 5% to 6% of national bath tissue capacity. Adler said K-C's new Kleenex product absorbed some of P&G's market share, which is almost 30% of the overall bathroom tissue market and near 45% of the premium sector. James River has about 30% of the premium sector. And Georgia-Pacific Corp. and Scott each hold about 10% of the premium bath tissue market, according to Morgan Stanley's Carroll. She said the total U.S. bath tissue market is about 2 million tpy—or about 40% of the overall tissue market—and that premium products account for somewhat more than half of the bath tissue sector.

K-C also brought a new service and industrial tissue mill online in Loudon, Tenn., in third-quarter 1990 and added a second tissue machine in the fourth quarter, reportedly bringing capacity to 50,000 tpy. The company plans to start up a third at the Loudon mill, along with related deinking and converting equipment. Carroll predicts the machine could come on in first-half 1993 with capacity of 50,000 tpy. The facility produces 100%-recycled Surpass and Regard brand commercial bathroom tissue.

K-C introduced its first baby wipes product in fall 1990. Nonwoven fabric produced at its Conway, Ark., facility is shipped to a new converting plant nearby in Maumelle, Ark., to be made into premoistened Huggies baby wipes. K-C plans to invest $50 million in a significant expansion of the Maumelle plant. K-C initially marketed the wipes in California but has now expanded coverage to one-third of the U.S.

Baby wipes comprise a $350-million market at the retail level in the U.S., according to K-C, and the sector is growing 5% to 10%/year. The leader in the baby wipes field is Scott, with a 50% share of the market.

James River has had to shell out funds to compete with K-C's new premium consumer bath tissue and P&G's energetic response to it. Carroll said JR will not undertake proposed tissue machines at Naheola and Old Town until the firm completes restructuring begun in 1990. When these machines do come on they will replace existing capacity, probably adding just 20,000 tpy or so. In the meantime, JR identified eight machines that could be rebuilt over the next two or three years for incremental capacity, she said.

James River planned to build a $65-million wastepaper recycling plant at its Halsey, Ore., tissue mill by mid-1992. The secondary fiber will primarily replace virgin fiber (rather than increase overall tissue capacity) and will buffer the firm against the rising woodfiber costs in the Pacific Northwest.

Procter & Gamble has announced a number of expensive expansions, although the timing of these projects is uncertain. In 1990, P&G said it planned to pump about $250 million into two new paper machines at an existing P&G plant east of the Rockies to supply the consumer toilet tissue and paper towel market. The company also announced it was planning a $100-million tissue and towel expansion, including a new machine in Oxnard. P&G restarted the idled No. 3 paper machine at its East River Mill in Green Bay, Wis., toward the close of 1990. The plant makes sanitary tissue and household paper products. The machine, which was idle for about three years, is used to produce Banner and White Cloud toilet tissue.

P&G is a major player in the U.S. disposable diaper

U.S. SHIPMENTS OF TISSUE PAPER, EXCLUDING SANITARY AND THIN PAPER

(000 short tons)

Year	Total tissue paper[1]	Wrapping tissue	Waxing tissue stock	Twisting tissue stock	Creped wadding[2]	Other tissue paper
1989	160	77	(D)	—	(D)	33
1988	163	77	(D)	—	(D)	36
1987	145	69	(D)	—	(D)	28
1986	130	59	(D)	—	(D)	23
1985	126	56	(D)	—	(D)	23
1984	136	69	(D)	—	(D)	31
1983	110	(D)	(D)	—	(D)	20
1982	106	(D)	(D)	—	(D)	21
1981	114	(D)	(D)	—	(D)	25
1980	176	72	24	13	25	18
1979	198	63	31	14	41	21
1978	210	74	32	12	37	29
1977	197	74	26	9	35	28
1976	193	61	37	8	30	30
1975	178	47	39	7	34	22
1974	224	44	49	10	46	41

(D) = Data withheld to avoid disclosing figures for individual companies.
1. Excluding sanitary and thin.
2. Creped wadding for interior padding.
Source: Bureau of the Census.

business. The company holds about 50% of the diaper market, followed by Kimberly-Clark with about 35% and private-label products with about 15%. Disposable diapers have encountered some customer backlash because they account for 1% to 2% of the waste going to landfills. That has led firms, including P&G, to look into recycling materials, such as pulp, recovered from used diapers. P&G is also supporting composting research and is developing a diaper that is more fully compostable than its current brands. This product was expected to enter the test market by 1992.

Scott hopes to begin construction of a $200-million Owensboro, Ky., tissue mill in 1992. The company planned in 1991 to start up a rebuilt machine at its tissue and toweling mill in Chester, Pa., where another rebuilt machine that had been idled went online toward the close of the previous year. Dean Witter analyst Evadna Lynn estimated that the first rebuild added 20,000 tpy.

Scott debuted ScotTowels Mega Roll in the U.S. in 1990 and ScotTissue Supreme, a one-ply bath tissue with 800 sheets/roll, in 1991.

Scott continues to expand its overseas reach. In October 1990, the company linked up with Feldmühle AG in a 51:49 joint venture to own and operate the West German firm's sanitary tissue facilities. Feldmühle brings in about $300 million in gross annual sales from that business. Scott will put $125 million into the venture and retains the option to buy Feldmühle out. The principal products involved in the transaction include consumer and commercial bathroom tissue.

Mosinee Paper Corp.'s Bay West Paper Co. converting operation has been supplied with tissue from the firm's Sorg Paper Co. subsidiary as well as from the open market. But during 1990, construction and rebuilding of a former Sorg Paper mill in Middletown, Ohio, was begun to give Bay West an in-house supply of towel and tissue papers. The mill was transferred to Bay West when Sorg Paper was downsized. The mill's tissue and towel machines were due online by the end of 1991, along with a second deinked pulp system. They will provide 90,000 tpy of 100%-recycled commercial tissue and towel paper to the converting operation, doubling its 1990 output. Also as part of the $90-million project, Bay West moved its headquarters and converting operations from Green Bay to Harrodsburg, Ky., closer to the tissue production site and the center of its customer base. In addition to existing equipment being moved in, new converting lines were scheduled to be installed by the end of 1992.

Potlatch Corp. planned to shut down an old tissue machine and start up a new one at its Lewiston, Idaho, mill by September 1992. The $90-million effort will bring mill capacity for private-label and generic consumer tissue to 120,000 tpy, up from 85,000 tpy.

Fort Howard Corp. started up a fourth 100%-recycled tissue machine in March 1991 at its Savannah River Mill in Rincon, Ga.; the machine will ultimately hike the facility's capacity 30%, or an estimated 88,000 tpy, with the tissue going primarily to the C&I market. In a $180-million project, the company also reportedly started to build a machine

U.S. SHIPMENTS OF SANITARY TISSUE

(000 short tons)

Year	Total sanitary paper	Toilet tissue			Facial tissue	Napkin			Toweling[1]	Sanitary napkin wadding	Wiper stock[2]	Other sanitary stock
		Total	Single-ply	Multi-ply		Total	Single-ply	Multi-ply				
1989	5,291	2,097	1,156	941	332	699	519	180	1,858	(D)	156	150
1988	5,019	1,921	1,141	779	326	679	506	173	1,767	(D)	186	141
1987	4,740	1,798	1,077	721	301	623	432	194	1,715	(D)	178	122
1986	4,638	1,809	1,127	681	303	595	431	165	1,644	(D)	156	131
1985	4,494	1,833	1,198	635	302	596	451	144	1,521	(D)	111	131
1984	3,953	1,489	955	534	285	529	400	128	1,363	73	108	104
1983	4,337	1,742	941	802	292	594	467	127	1,449	99	60	99
1982	4,185	1,679	962	717	277	532	407	125	1,433	113	56	94
1981	3,917	1,533	944	588	298	474	341	133	1,253	116	129	114
1980	4,298	1,706	939	766	370	532	409	123	1,439	—	251	—
1979	4,403	1,772	978	794	376	533	404	129	1,482	86	240	—
1978	4,036	1,629	939	690	383	429	317	116	1,376	73	57	76
1977	4,045	1,605	877	729	365	370	353	117	1,388	73	48	96
1976	3,936	1,578	933	645	359	448	342	106	1,335	53	52	90
1975	3,669	1,422	828	594	374	436	334	102	1,230	69	62	89
1974	3,799	1,415	834	581	395	439	345	93	1,308	—	55	119

(D) = Data withheld to avoid disclosing figures for individual companies.

1. Excludes wiper stock but includes facial tissue stock for towels.
2. Regular, facial, and wadding type.

Source: Bureau of the Census, "Current Industrial Reports Series MA26A."

at its mill in Green Bay. The tissue machine, due online in first-quarter 1993, will increase the mill's capacity 20%.

Wisconsin Tissue Mills Inc.'s new No. 4 paper machine went online at its Menasha, Wis., tissue facility in June 1990, marking the end of a $160-million expansion begun in 1986. The project also entailed the installation of 39 converting machines, wastewater treatment facilities, and recycling and deinking capacity. The new Beloit twin-wire paper machine will hike 100%-recycled C&I tissue capacity by 80,000 tpy to 200,000 tpy and will be used to make dry crepe tissue and wet crepe toweling. The debut of the new machine is a relief to parent Chesapeake Corp. The firm's policy of buying and converting jumbo tissue rolls to build sales in anticipation of the startup was costing the company $1 million/month.

Shelby Tissue Inc. is building a $35-million, private-label bathroom tissue mill in Memphis, Tenn., and plans to use deinked pulp feedstock supplied by Ponderosa Fibres of America Inc.'s adjacent mill. The tissue mill should be running by 1992. The Shelby mill's capacity will top 100 tpd of lightweight tissue.

American Tissue Corp., a converter based in Hauppauge, N.Y., acquired Erving Paper Co.'s Consumer Products Div. for undisclosed terms in 1991. The purchase included paper mills in Lockwood, Ohio, and Baldwinville, Mass. American Tissue wanted to extend its operations from converting back through papermaking so it would not have to depend on outside sources for paper. The Lockwood and Baldwinville plants gave American Tissue the ability to produce 100%-recycled towels and napkins. American Tissue produces napkins, facial tissue, and bathroom tissue, primarily for the private-label consumer market.

Canadian blues. As in the U.S., the tissue sector sagged in Canada. In spite of a drop in raw material costs, finished products prices dropped faster. And new capacity heated up competition in the market. Robert Stewart, president and CEO of market dominator Scott Paper Ltd., said industry capacity would be 30% greater by mid-1991 than it was back in 1989. He noted that the rate of expansion would be well in excess of total market growth during the same period and more typically would have occurred over five years than two. The new projects included four in 1990: at Irving Tissue Ltd., Canadian Pacific Forest Products Ltd., Atlantic Packaging Products Ltd., and Cascades Inc.

Perkins Papers Ltd. planned to start up a new 48,500-short-tpy No. 2 Valmet paper machine at its Candiac, Que., tissue mill in August 1991. The C$50-million project will more than double recycled tissue capacity at the facility and includes a new deinking line and bleaching expansion. The mill produces toilet tissue, napkins, and kitchen towels for commercial and consumer markets, primarily from 100%-recycled paper.

U.S. MARKET INDICATORS FOR PERSONAL CARE PRODUCTS

(billion units)

Year	Diapers	Feminine pads	Tampons	Incontinence products*
1990	16.5	11.3	5.4	499
1989	16.0	11.0	5.3	442
1988	15.8	10.6	5.2	388
1987	15.8	10.1	5.0	309
1986	15.8	9.5	4.9	256

*Million units.
Source: Kimberly-Clark Corp.

NORTH AMERICAN TISSUE EXPANSIONS

Startup date	Company	Mill	Annual capacity (short tons)
1990	Irving Tissue	St. John, N.B.	n.a.
1990	Atlantic Packaging	Whitby, Ont.	30,000
1990	Kimberly-Clark	Loudon, Tenn.	50,000e
1990	Kimberly-Clark	Jenks, Okla.	75,000
1990	Cascades	Kingsey Falls, Que.	28,000
1990	Wisconsin Tissue	Menasha, Wis.	80,000
1990	Putney Paper	Putney, Vt.	5,000[1]
1990	Pope & Talbot	Ransom, Pa.	7,000[1]
1990	Canadian Pacific	Toronto, Ont.	n.a.
1990	Scott Paper	Chester, Pa.	20,000e
1991	Scott Paper	Chester, Pa.	n.a.
1991	Mosinee Paper	Middletown, Ohio	90,000
1991	Perkins Papers	Candiac, Que.	48,500
1991	Fort Howard	Rincon, Ga.	88,000
1992	Procter & Gamble	Oxnard, Calif.	n.a.
1992	Potlatch	Lewiston, Idaho	39,000[2]
1992	Consumers Paper	Redcliff, Alta.	28,000
1993	Fort Howard	Green Bay, Wis.	n.a.
1993	Kimberly-Clark	Loudon, Tenn.	50,000e

n.a. = Not available.
e = Estimate.
1. Estimated capacity addition from rebuild.
2. Net capacity addition.
Source: *Pulp & Paper Week*, analyst estimates.

Consumers Paper Corp. targeted a 1992 startup for a paper recycling and tissue mill in Redcliff, Alta. The mill is expected to produce 25,000 to 28,000 metric tpy of bath tissue, toweling, and napkins for both the consumer and C&I markets.

In mid-1991, Canadian Pacific Forest Products sold its Facelle Co. Ltd. tissue unit to Procter & Gamble's Canadian subsidiary for C$185 million. The unit's 1990 sales reached C$170.5 million, down from $177.7 million in 1989, while earnings were nearly flat at $13.4 million. P&G picked up all Facelle operations, including a Toronto, Ont., tissue manufacturing plant and the unit's franchise for facial and bathroom tissues and paper towels. Facelle's trademarks include Royale, Florelle, Pronto, Dove, Facettes, and Festival. Facelle has capacity for 80,000 metric tpy, and its sales are concentrated in Ontario and Quebec. P&G's only tissue-related facility already in Canada was a diaper and sanitary napkin facility in Belleville, Ont. The Facelle purchase moved P&G up into second place behind Scott Paper. P&G said it would continue to market the Facelle line and would probably introduce some P&G products as well.

ESTIMATED ANNUAL CAPACITIES FOR TISSUE OF MAJOR PRODUCERS

(000 short tons)

	U.S.	Share of U.S. capacity (%)	Canada	Share of Canadian capacity (%)	Company total
1. Scott Paper	1,150	18.8%	250	37.3%	1,400
2. James River	1,150	18.8	—	—	1,150
3. Fort Howard	950	15.5	—	—	950
4. Procter & Gamble	810	13.3	88	13.1	898
5. Kimberly-Clark	548	9.0	61	9.1	609
6. Georgia-Pacific	567	9.3	—	—	567
7. Chesapeake	190	3.1	—	—	190
8. Pope & Talbot	145	2.4	—	—	145
9. Orchids Paper Products	110	1.8	—	—	110
10. Mosinee Paper	90	1.5	—	—	90
11. Marcal Paper Mills	88	1.4	—	—	88
12. Cascades	17	0.3	70	10.4	87
13. Potlatch	85	1.4	—	—	85
14. Perkins Papers	—	—	85	12.7	85
15. Irving Pulp & Paper*					83

U.S. annual capacity (1991e): 6.113 million short tons
Canadian annual capacity (1991e): 0.67 million short tons

*Breakdown between U.S. and Canada not available.
e = Estimate.

U.S. TISSUE PRICES

(BLS price index, 1987 = 100)

Year	Napkins and stock	Toilet tissue and stock	Towels and stock
1991			
2Q	111.9	133.5	122.0
1Q	111.9	133.8	120.4
1990			
4Q	112.4	134.3	120.7
3Q	112.5	134.5	119.6
2Q	112.9	134.5	121.5
1Q	111.6	131.7	118.9
1989			
4Q	110.7	131.3	119.0
3Q	109.6	118.6	118.4
2Q	108.9	116.3	117.9
1Q	107.3	110.9	116.3
1988			
4Q	103.8	106.8	113.3
3Q	103.1	105.6	110.1
2Q	102.7	103.6	105.4
1Q	100.8	100.8	100.5

Source: U.S. Dept. of Labor, Bureau of Labor Statistics, Producer Price Indexes.

U.S. MARKET INDICATORS FOR TISSUE PRODUCTS

(billion units)

Year	Facial tissue (two-ply)	Disposable household towels (jumbo rolls)	Bathroom tissue (rolls)
1990	188	2.7	10.1
1989	192	2.6	9.9
1988	196	2.6	9.6
1987	196	2.5	9.1
1986	194	2.4	8.7
1985	190	2.4	8.6
1984	191	2.3	8.1
1983	190	2.2	7.7
1982	188	1.9	6.9
1981	183	1.8	6.6
1980	179	1.8	6.7
1979	181	1.7	6.6
1978	181	1.6	6.5
1977	180	1.5	6.3
1976	182	1.5	5.8
1975	177	1.4	5.3

Source: Kimberly-Clark Corp.

U.S. TISSUE PRICES

(BLS price index, 1982 = 100)

Year	Sanitary paper products, including stock
1991	
2Q	136.8
1Q	136.4
1990	
4Q	136.1
3Q	135.8
2Q	136.1
1Q	133.5
1989	
4Q	132.8
3Q	125.8
2Q	124.4
1Q	120.6
1988	
4Q	117.3
3Q	116.1
2Q	113.3
1Q	109.5
1987	109.1
1986	108.1
1985	106.6
1984	103.4
1983	102.1
1982	100.0
1981	98.2
1980	91.9
1979	79.1
1978	71.7
1977	66.9
1976	60.6
1975	55.0
1974	44.0
1973	35.3
1972	34.2
1971	33.8
1970	32.5

Note: Bureau of Labor Statistics' Producer Price Index was rebased to 1982 = 100 in January 1988. Index now includes sanitary products and stock.
Source: U.S. Dept. of Labor, Bureau of Labor Statistics, Producer Price Indexes.

Paperboard:

INTRODUCTION

Paperboard is a general term describing heavyweight grades of paper used for containers, boxes, cartons, and packaging materials. Paperboard is divided into three classes: containerboard, boxboard, and other paperboard.

Containerboard is the largest single grade of paperboard produced and includes three major grade categories: linerboard, corrugating medium, and chip and filler boards. Most of these grades are made from 100% virgin kraft fiber on a fourdrinier paper machine, but some recycled fiber is also used. The bulk of containerboard produced in the U.S. is consumed by domestic corrugated container plants, but a substantial proportion of linerboard—approximately 2.6 million tons in 1990—is exported.

Boxboard grades include folding boxboard, setup boxboard, and food board. Folding boxboard is paperboard that is die cut to be folded into a carton. These cartons are used to package health and beauty products, dry cereals, soap powders, electronics, toys and hardware, and other common consumer products. Folding boxboard is made from either solid bleached sulfate or solid unbleached sulfate kraft pulp on a fourdrinier paper machine, or it can be made from 100% recycled fiber on a multi-ply cylinderboard machine. Folding carton stock is usually clay coated for better printability and consumer appeal.

Setup boxes are rigid or semirigid boxes used in specialty packaging applications. They are custom-produced and usually hand-filled with products such as shoes, jewelry, cosmetics, liquor, and candy. Setup boxes are also used to package personal computer software products.

Food board is normally produced from bleached kraft pulp on a fourdrinier paper machine. Several grades are available, each specially coated, waxed, or otherwise treated for packaging moist or oily food products. Typical grades are milk cartons, frozen food packages, ice cream cartons, cup stock, and plates.

Other paperboard includes unbleached kraft or recycled grades made on either cylinder or fourdrinier paper machines. These grades are used in industrial converting applications, including fiber can, core, and drum stock and liner for gypsum board. Chipboard (commonly called cardboard) is used for products ranging from stationery pads to game boards.

Total U.S. paperboard production in 1990 was 39.4 million short tons—virtually equal to total paper production of 39.4 million tons, according to the American Paper Institute. Although paper and paperboard production are about equal on a tonnage basis, the dollar value of paper shipments is much greater than paperboard. In 1990, the value of paper shipments was approximately $33.4 billion, and the value of paperboard shipments was $16.2 billion, according to data published by the U.S. Dept. of Commerce.

Containerboard is the most important paperboard grade segment, with 1990 production for domestic use totaling 24.7 million tons. Boxboard output for the domestic packaging market was 6.9 million tons, and all other types of paperboard totaled 4.1 million tons. Paperboard exports, with linerboard and solid bleached board by far the most important categories, totaled about 3.6 million tons in 1990. About 77% of U.S. paperboard tonnage is produced mostly from woodpulp, and 23% of paperboard is produced from 100% wastepaper.

The Canadian paperboard industry is much smaller, with a total output in 1990 of about 2.8 million metric tons, according to the Canadian Pulp & Paper Assn. Linerboard is the most important grade, with 1990 output of 1.3 million metric tons. Corrugating medium production totaled 741,000 metric tons, and total boxboard production amounted to 761,000 metric tons.

U.S. MARKET INDICATORS FOR PAPERBOARD CONSUMPTION

Year	Paperboard consumption (million tons)	Gross national product[1]	Personal consumption expenditures Durable (billion 1982 constant $)	Personal consumption expenditures Nondurable (billion 1982 constant $)	U.S. total industrial production index (1977 = 100)	Paperboard manufacturing capacity utilization
1990	35,829	4,157	$427.4	$911.1	141.6	94%
1989	35,232	4,118	428.0	919.9	140.4	94
1988	34,804	4,017	418.2	909.4	136.8	95
1987	34,253	3,845	391.4	892.7	129.8	96
1986	32,454	3,718	384.4	878.1	125.1	95
1985	30,373	3,607	352.7	849.5	124.2	90
1984	31,551	3,501	323.1	825.9	121.4	94
1983	29,333	3,279	283.1	880.2	109.2	91
1982	26,526	3,166	252.7	771.0	103.1	82
1981	28,741	3,249	250.8	764.9	111.0	91
1980	27,716	3,187	245.9	762.6	108.8	92
1979	29,250	3,192	266.5	766.6	110.7	94
1978	28,335	3,115	267.4	753.7	106.6	93
1977	27,150	2,959	253.9	731.4	100.0	90
1976	26,744	2,827	232.3	708.8	92.6	89
1975	23,311	2,695	205.6	676.5	84.6	79
1970	23,495	2,417	162.5	632.5	78.5	92
1965	20,301	2,088	134.6	543.2	66.1	93
1960	15,475	1,665	98.0	463.3	n.a.	82

Sources: U.S. Dept. of Commerce, American Paper Institute.
1. Real GNP 1982 $.

U.S. PRODUCTION AND CAPACITY OF PAPERBOARD

(000 short tons)

Year	Production[1] (000 tons)	Production[1] Change (%)	Capacity[1] (000 tons)	Capacity[1] Change (%)	Utilization rate (%)
1992e	—	—	44,384	2.5%	—
1991e	—	—	43,292	3.5	—
1990	39,423	2.4%	41,828	2.0	94.3%
1989	38,519	1.1	40,993	1.7	94.0
1988	38,105	1.8	40,322	2.6	94.5
1987	37,442	5.9	39,106	3.5	95.7
1986	35,355	7.4	37,763	2.8	94.6
1985	32,922	-3.3	36,720	2.0	90.0
1984	34,039	6.5	35,992	1.1	95.6
1983	31,951	9.9	35,603	0.5	89.7
1982	29,065	-6.9	35,421	2.8	82.1
1981	31,232	0.9	34,466	1.6	91.2
1980	30,952	-1.9	33,709	0.8	91.8
1979	31,429	3.8	33,436	2.5	94.0
1978	30,275	4.6	32,631	1.4	92.8
1977	28,953	1.8	32,173	0.2	90.0
1976	28,439	14.8	32,097	2.8	86.0
Average 1976-90		2.8%		2.2%	

e = Estimate.
1. Excludes capacity for hard pressed board, wet machine board, and construction paper and board.
Source: American Paper Institute (1990 capacity survey).

U.S. SHIPMENTS[1] OF PAPERBOARD GRADES, 1976-89

(000 short tons)

	1989	1988	1987	1986	1985	1984	1983
TOTAL PAPERBOARD	38,047	37,763	37,187	36,002	33,291	33,515	31,871
SOLID WOODPULP FURNISH PAPERBOARD	28,899	28,492	28,083	27,897	25,293	25,619	24,169
Unbleached kraft packaging, industrial converting	18,795	18,298	18,222	17,997	16,016	16,718	15,750
Unbleached linerboard	17,356	16,902	16,919	16,740	14,897	16,648	14,689
Tube, can, and drum paperboard	60	68	65	54	64	74	99
Other, including corrugating medium	1,379	1,328	1,238	1,202	1,055	996	962
Bleached packaging, industrial converting (80% bleached fiber)	4,906	4,973	4,636	4,535	4,282	4,104	3,988
Linerboard	445	523	405	121	(D)	118	113
Folding carton-type board	2,212	2,245	2,023	2,706	955	1,895	1,901
Milk carton board	1,143	1,092	1,116	1,226	1,227	1,092	1,060
Heavyweight cup stock	426	500	486	442	422	455	440
Plate, dish, and tray stock	323	274	270	276	245	225	252
Bleached paperboard for miscellaneous packaging	73	59	55	45	29	31	31
Other solid bleached board	284	280	281	348	404	288	191
Semichemical, including corrugating medium, other	5,199	5,222	5,226	5,365	4,995	4,798	4,431
RECYCLED PAPERBOARD	9,046	9,169	9,001	8,004	7,901	7,797	7,604
Recycled shipping containerboard	3,090	3,151	3,131	2,495	2,561	2,407	2,565
Linerboard	848	917	1,029	761	918	846	879
Corrugating medium	2,044	2,034	1,950	1,568	1,486	1,397	1,519
Container chip and filler board	198	200	152	167	157	164	167
Recycled folding carton board	2,564	2,589	2,561	2,284	2,268	2,310	2,370
Unlined chipboard	562	556	537	441	468	471	585
Kraft-lined	113	137	162	219	203	169	180
White-lined	142	140	130	168	193	225	227
Clay-coated	1,747	1,756	1,732	1,456	1,401	1,447	1,378
Recycled setup paperboard	292	300	240	273	259	307	263
Recycled packaging, industrial converting board	3,099	3,129	3,070	2,950	2,814	2,772	2,406
Tube, can, and drum stock	1,146	1,151	1,124	1,042	1,021	1,064	858
Gypsum linerboard	1,198	1,239	1,227	1,145	1,029	915	798
Panelboard and wallboard stock	23	35	48	64	68	150	148
Other	733	704	671	698	646	643	602
WET MACHINE BOARD	102	101	103	101	98	99	98
CONSTRUCTION PAPER AND BOARD	2,546	2,486	2,615	2,967	3,228	3,010	3,215
Construction paper	335	356	327	302	398	394	463
Sheathing (red rosin, asphalt, house sheathing)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Felts, saturating and dry							
Roofing felts	239	256	232	210	302	(D)	(D)
Other felts, including floor covering	(D)	90	(D)	(D)	(D)	(D)	(D)
Asbestos and asbestos-filled (e.g., electrolytic)	—	(D)	(D)	(D)	(D)	(D)	(D)
Other building (saturating screenings, etc.)	—	—	—	—	—	(D)	(D)
Structural insulation board		—	—	—	—	—	—
Insulating board	518	529	609	732	735	785	713
Hard pressed board	1,694	1,601	1,683	1,933	2,095	1,831	2,040

Continued

U.S. SHIPMENTS[1] OF PAPERBOARD GRADES, 1976-89 (continued)

(000 short tons)

	1982	1981	1980	1979	1978	1977	1976
TOTAL PAPERBOARD	28,912	30,566	31,143	31,168	30,033	29,006	27,960
SOLID WOODPULP FURNISH PAPERBOARD	22,145	23,950	23,901	23,585	22,500	21,580	21,008
Unbleached kraft packaging, industrial converting	14,390	15,707	15,285	14,903	14,113	13,498	13,146
Unbleached linerboard	13,297	14,431	14,249	13,857	13,215	12,660	12,267
Tube, can, and drum paperboard	151	334	220	232	202	180	194
Other, including corrugating medium	941	942	(D)	(D)	(D)	(D)	(D)
Bleached packaging, industrial converting (80% bleached fiber)	3,757	4,070	4,034	4,065	4,002	3,883	3,846
Linerboard	101	120	(D)	(D)	(D)	93	103
Folding carton-type board	1,743	1,921	2,063	2,045	1,934	1,822	1,888
Milk carton board	1,052	1,085	1,023	1,066	1,048	1,040	1,061
Heavyweight cup stock	418	427	386	375	400	419	363
Plate, dish, and tray stock	227	245	273	260	227	296	267
Bleached paperboard for miscellaneous packaging	32	49	33	46	67	55	70
Other solid bleached board	184	222	78	94	117	106	77
Semichemical, including corrugating medium, other	3,998	4,173	4,583	4,617	4,384	4,199	4,016
RECYCLED PAPERBOARD	6,607	6,616	7,242	7,583	7,533	7,426	6,952
Recycled shipping containerboard	2,097	1,750	2,070	2,050	1,981	1,908	1,468
Linerboard	505	250	518	460	331	379	232
Corrugating medium	1,427	1,315	1,281	1,301	1,408	1,286	1,057
Container chip and filler board	165	185	271	290	242	243	179
Recycled folding carton board	2,153	2,425	2,350	2,386	2,403	2,423	2,475
Unlined chipboard	546	(D)	606	678	692	687	698
Kraft-lined	146	176	81	98	130	133	145
White-lined	152	189	220	229	251	274	325
Clay-coated	1,308	(D)	1,443	1,380	1,330	1,329	1,307
Recycled setup paperboard	238	298	560	604	697	717	748
Recycled packaging, industrial converting board	2,119	2,144	2,262	2,543	2,453	2,378	2,261
Tube, can, and drum stock	767	808	564	628	602	680	747
Gypsum linerboard	598	634	1,036	1,210	1,185	1,099	976
Panelboard and wallboard stock	119	100	113	137	119	114	86
Other	635	601	548	568	546	485	452
WET MACHINE BOARD	172	—[2]	138	144	136	129	130
CONSTRUCTION PAPER AND BOARD	2,781	1,460[3]	4,390	5,436	5,625	5,492	5,419
Construction paper	447	616	1,369	1,868	1,915	1,852	1,832
Sheathing (red rosin, asphalt, house sheathing)	(D)	(D)	3	14	13	21	22
Felts, saturating and dry							
Roofing felts	(D)	510	1,205	1,633	1,672	1,601	1,553
Other felts, including floor covering	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Asbestos and asbestos-filled (e.g., electrolytic)	(D)	(D)	62	100	113	106	114
Other building (saturating screenings, etc.)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Structural insulation board	—	—	3,021	3,569	3,710	3,640	3,586
Insulating board	593	845	1,051	1,263	1,416	1,403	1,441
Hard pressed board	1,741	(S)	1,970	2,306	2,294	2,237	2,145

Note: Categories shown are those now used by Bureau of the Census. Categories in older reports do not always correspond to the present ones.
(D) = Data withheld to avoid disclosing figures for individual companies.
(S) = Suppressed because the data did not meet publication standards by Bureau of the Census.

[1] Reported as production by Bureau of the Census prior to 1981. Annual information no longer available after 1989.

[2] Wet machine board included with recycled paperboard to avoid disclosing figure for individual companies.

[3] Excludes hardboard.

Source: Bureau of the Census.

U.S. PRODUCTION OF CONTAINERBOARD FOR DOMESTIC USE

(000 short tons)

Year	Total[1]	Linerboard			Corrugating materials			Chip and filler boards
		Kraft[2]	Recycled	Total	Semichemical and kraft	Recycled	Total	
1990	24,431.6	16,552.7	322.7	16,875.4	5,567.4	1,981.8	7,549.2	7.0
1989	23,752.0	16,011.0	388.0	16,399.0	5,554.0	1,785.0	7,339.0	14.0
1988	23,563.2	15,770.7	406.6	16,177.3	5,527.7	1,823.2	7,350.9	35.0
1987	23,047.1	15,514.4	478.3	15,992.7	5,343.8	1,673.1	7,016.9	37.5
1986	21,446.0	14,305.5	420.3	14,725.8	5,163.5	1,525.8	6,689.3	30.9
1985	20,042.2	13,467.1	285.8	13,752.9	4,896.6	1,358.8	6,255.4	33.9
1984	20,855.1	14,068.8	203.7	14,272.5	5,018.9	1,385.4	6,404.3	178.4
1983	19,173.0	12,835.6	289.1	13,124.7	4,532.7	1,305.4	5,838.1	210.2
1982	17,507.5	11,656.5	279.0	11,935.5	4,202.5	1,139.3	5,341.8	230.2
1981	19,040.4	12,754.3	324.2	13,078.5	4,561.2	1,140.9	5,702.1	259.5
1980	18,070.2	11,948.6	444.5	12,393.1	4,398.5	1,047.1	5,445.6	231.5
1979	18,824.8	12,417.3	402.3	12,819.6	4,573.6	1,202.3	5,775.9	229.3
1978	17,908.2	11,877.2	256.4	12,133.7	4,305.3	1,197.7	5,503.1	271.5
1977	17,167.3	11,354.4	341.3	11,695.7	4,128.2	1,079.7	5,207.9	263.7
1976	16,700.2	11,093.2	282.7	11,375.9	3,986.5	1,075.1	5,061.5	262.9
1975	14,586.2	9,646.9	207.3	9,854.2	3,579.4	870.0	4,449.3	282.6
1970	13,964.3	9,133.4	269.7	9,403.1	3,404.7	859.3	4,264.0	297.2

1. Balance of tube, drum, miscellaneous not included.
2. Includes some bleached kraft linerboard—140,000 tons (1990).

Source: American Paper Institute.

U.S. PRODUCTION OF BOXBOARD AND OTHER PAPERBOARD FOR DOMESTIC AND EXPORT USE

(short tons)

Year	Boxboard—domestic use				Other*
	Total	Folding	Setup	Milk carton and food service	
1990	6,949,000	5,198,000	290,000	1,461,000	8,042,000
1989	7,076,000	5,370,000	288,000	1,419,000	7,628,000
1988	7,013,600	5,292,200	278,700	1,442,700	7,527,800
1987	6,874,100	5,209,700	242,500	1,421,900	7,520,800
1986	6,671,100	5,056,500	219,300	1,395,300	7,238,300
1985	6,412,800	4,805,100	226,600	1,381,100	6,466,800
1984	6,535,600	4,876,000	263,800	1,395,800	6,648,500
1983	6,261,100	4,646,000	256,300	1,358,800	6,742,700
1982	5,841,000	4,333,700	223,600	1,283,700	5,716,900
1981	6,216,100	4,587,600	236,000	1,392,500	5,976,100
1980	6,153,100	4,489,900	241,500	1,421,700	6,729,000
1979	6,469,200	4,720,500	306,000	1,442,700	6,135,000
1978	6,501,200	4,702,400	332,700	1,466,100	5,865,500
1977	6,332,300	4,546,700	302,500	1,483,100	5,453,500
1976	6,564,700	4,714,600	331,500	1,518,600	5,174,500
1975	5,663,800	3,896,400	304,500	1,462,900	4,505,700
1970	6,238,700	4,079,700	466,500	1,692,500	5,180,000

*Including other boxboard—4,145,000, boxboard exports—941,000, other containerboard—282,000, and containerboard exports—2,674,000.

Source: American Paper Institute.

CANADIAN PAPERBOARD CAPACITY

(000 short tons)

Year	Linerboard		Corrugating medium		Solid bleached board	Boxboard Folding, others[1]
	Kraft	Recycled	Semichemical	Recycled		
1992e	1,190	442	804	124	206	843
1991e	1,149	436	796	125	184	825
1990	1,079	434	734	112	150	816
1989	1,076	408	668	173	69	814
1988	1,076	402	623	170	69	785
1987	1,036	361	609	157	68	782
1986	1,022	325	586	161	80	774
1985	1,001	321	565	172	92	787
1984	983	314	576	164	95	785
1983	952	315	581	129	98	747
1982	969	300	564	150	104	732
1981	1,069	322	557	129	102	770
1980	1,056	289	545	114	105	785
1979	1,074	267	520	115	137	832
1978	1,069	272	517	116	135	812

e = Estimate.

1. Includes recycled boxboard and mill wrappers.

Source: Canadian Pulp & Paper Assn.

CANADIAN EXPORTS OF PAPERBOARD[1]

(000 short tons)

Year	Linerboard	Corrugating medium	Boxboard
1990	395	201	252
1989	344	212	112
1988	348	246	75
1987	358	241	88
1986	352	220	73
1985	321	151	69
1984	271	218	95
1983	310	197	63
1982	213	158	31
1981	295	170	37
1980	361	201	40
1979	288	157	39
1978	283	177	54
1977	393	105	20
1976	318	90	7
1975	198	53	11
1974	414	96	22
1973	311	140	23
1972	222	147	17
1971	173	133	22
1970	201	102	13
1965	123	46	16

1. Canadian imports of paperboard are minor. For example, in 1986, Canada imported 43,000 tons of containerboard.

Source: Canadian Pulp & Paper Assn.

CANADIAN PAPERBOARD PRODUCTION

(000 short tons)

	Containerboard		Boxboard				
Year	Liner-board	Corrugating medium	Recycled folding	Bleached board	Non-folding	Other[1]	Total paper-board
1990	1,434	815	399	115	72	252	3,087
1989	1,340	798	430	62	66	272	2,968
1988	1,371	781	358	64	62	238	2,970
1987	1,383	769	n.a.	n.a.	n.a.	n.a.	2,966
1986	1,322	714	391	—[2]	114	353	2,836
1985	1,187	549	385	—[2]	111	332	2,564
1984	1,128	626	363	—[2]	142	329	2,588
1983	1,026	589	355	—[2]	128	295	2,391
1982	967	466	305	—[2]	115	270	2,123
1981	1,182	571	331	—[2]	130	328	2,541
1980	1,224	527	310	—[2]	118	322	2,499
1979	1,145	483	315	—[2]	119	373	2,434
1978	1,146	459	272	—[2]	133	354	2,364
1977	1,011	376	238	—[2]	133	209	2,066
1976	1,025	373	224	—[2]	80	272	1,974
1975	784	343	192	—[2]	101	238	1,658
1970	776	373	250	107	111	233	1,850
1965	595	251	265	89	104	250	1,553
1960	375	208	233	14	65	172	1,067
1955	259	158	186	—	48	219	869
1950	214	152	158	4	48	204	708

n.a. = Not available.

1. Includes tube, can, drum, mill wrappers, gypsum or plasterboard, wet machine board, etc. from 1975 on.

2. Included in "Boxboard, Other."

Source: Canadian Pulp & Paper Assn., *Pulp & Paper* estimates.

Paperboard:

LINERBOARD

Linerboard is a commodity grade of paperboard used in the production of corrugated containers. It is used as the inner and outer facing (liner) in combination with corrugating medium (the fluted inner sheet) to form the rigid structure of the combined board. Linerboard provides the strength component of a container, while corrugating medium gives rigidity or stiffness. Linerboard is sold in rolls; the width of the roll is determined by the corrugator width.

Unbleached linerboard is made in a wide range of basis weights. The standard kraft liner is 42 lb/1,000 ft^2, but other important grades are produced in weights of 26, 33, 38, 69, and 90 lb. About 86% of linerboard is unbleached kraft (including mottled white), and the remainder is either solid bleached or recycled. Kraft linerboard is produced at large, integrated kraft pulp and paper mills. About 83% of U.S. linerboard capacity is located in the South, and most of the rest is in the West. Some linerboard is also produced in eastern Canada and British Columbia (see Corrugating Medium chapter for discussion of the Canadian industry).

Most linerboard is produced on wide (220- to 348-in. trim), conventional fourdrinier paper machines at speeds approaching 2,000 fpm or more. About 60% of industry capacity is now represented by machines with capacity to produce 300,000 to 500,000 tpy. About 90% of the linerboard machines in the industry have been installed or substantially rebuilt in the last two decades.

Normally, the wet end of the fourdrinier machine used to manufacture linerboard has two forming devices, or headboxes, that form two different plies, or layers, of fiber. The primary layer, comprising up to 85% of the fiber furnish, contains coarse, strong, high-yield kraft fiber, which means that a minimum amount of the natural binding chemicals contained in the wood is removed during the pulping process. The top layer contains higher-quality pulp (either of lower fiber yield or highly refined) with better sheet properties that permit a good printing surface. In some grades, the top layer may be bleached fiber used to produce a mottled white appearance over an unbleached basesheet.

Special chemical additives are either mixed into the pulp slurry or extruded onto the surface of the formed sheet to give linerboard its unique properties. The most common internal additives are sizes and wet-strength agents used to develop desired sheet strength and moisture resistance. About 4% of linerboard produced in the U.S. is wet-strength treated. The most common surface additive is starch, which is applied at a size press on the paper machine to seal the surface of the sheet for increased strength and printing smoothness.

Compression strength. Basis weight and bursting strength have historically been the two main quality specifications for linerboard under freight-carrier classifications (railroad Rule 41 and trucking Item 222) that regulate corrugated shipping containers. Bursting strength is simply a measure of how well a corrugated container will protect its

U.S. STATISTICS FOR UNBLEACHED KRAFT LINERBOARD

	1992e	1991e	1990
Production, 000 tons	20,015	19,165	18,935
Capacity, 000 tons[1]	20,779	20,271	19,611
Utilization rates, %	96.3	94.5	96.6
Imports, 000 tons	95	100	114
Exports, 000 tons	3,100	2,900	2,521
Apparent U.S. consumption			
000 tons	17,010	16,365	16,528
lb/capita	125.5	130.2	132.8
000 tons/billion $ real GNP	3.96	3.95	3.98

e = Estimate.

1. Based on 1990 American Paper Institute capacity survey.

contents during individual loading into railroad cars. Recently, many mills have begun producing linerboard and corrugating medium that also meet certain minimum ring crush standards. Ring crush relates to the top-to-bottom compression strength of the finished corrugated box, which is a critical measure of stacking height.

Increased transport and stacking of boxes on pallets have made compression strength an important measure of box performance (see Converted Products chapter). The movement toward performance-based packaging emphasizes the strength-to-weight ratio of corrugated packaging. Many companies have developed high-strength linerboard that allows box makers to use lighter-weight, yet stronger, packaging while reducing costs. This also reduces mill costs because less fiber is required to impart strength, and the linerboard produced typically has a lower basis weight, thus reducing fiber use overall. Among the largest producers of such high-performance containerboard are Union Camp Corp., Georgia-Pacific Corp., Stone Container Corp., and International Paper Co. Although the industry has no standard definition for such grades, some industry managers define high-performance containerboard as those grades of linerboard offering at least two pounds of ring crush strength for each pound of basis weight.

In early 1991, railroad and truck classification committees approved an alternate Rule 41 and Item 222, which would do the following: 1) replace mullen with compression strength as the most important measurement of box performance and 2) eliminate mandatory basis weight requirements. These changes would encourage the use of lighter-weight linerboard as long as it had the required ring crush or STFI (Swedish Pulp & Paper Research Institute) value.

William Driscoll, vice president of the American Paper Institute's containerboard division, told the Fourth International Unbleached Kraft Conference in New Orleans, La.,

U.S. PRODUCTION AND CAPACITY OF UNBLEACHED LINERBOARD

(000 short tons)

	UNBLEACHED KRAFT					RECYCLED	
	Production		Capacity			Production	
Year	Tonnage	Change (%)	Tonnage	Change (%)	Operating rate	Tonnage[2]	Change (%)
1993e	—	—	20,770	—	—	—	—
1992e	—	—	20,779	2.5%	—	—	—
1991e	—	—	20,271	3.4	—	—	—
1990	18,935	4.9%	19,611	2.2	96.6%	334	-13.9%
1989	18,057[1]	0.9[1]	19,192	2.6	94.1	388	-4.7
1988	17,897	1.2	18,705	1.6	95.7	407	-14.9
1987	17,683	7.8	18,415	7.2	96.0	478	13.8
1986	16,402	8.0	17,175	3.2	95.5	420	47.4
1985	15,183	-5.3	16,640	0.5	91.2	285	39.7
1984	16,037	6.9	16,565	2.1	96.8	204	-29.4
1983	15,007	11.2	16,217	1.2	92.5	289	3.6
1982	13,494	-7.2	16,032	4.3	84.2	279	-13.9
1981	14,540	2.2	15,372	5.4	94.6	324	-27.2
1980	14,232	2.0	14,586	2.7	97.6	445	10.7
1979	13,951	5.5	14,199	2.4	98.3	402	57.0
1978	13,228	5.2	13,864	2.0	95.4	256	-24.9
1977	12,573	2.6	13,586	1.0	92.5	341	20.5
1976	12,251	15.2	13,448	2.4	91.1	283	36.7
1975	10,635	-13.8	13,138	1.8	80.9	207	-55.7
1974	12,333	-1.6	12,901	0.3	95.6	467	61.6
1973	12,536	1.6	12,862	2.3	97.5	289	3.6
1972	12,335	9.1	12,568	6.5	98.1	279	-1.1
1971	11,308	3.0	11,797	0.5	95.9	282	4.4
1970	10,982	0.3	11,733	—	93.6	270	—

e = Estimate.
a = Adjusted by *Pulp & Paper*.
n.a. = Not available.
1. Includes exports of folding carton stock prior to 1989. Production with such exports in 1989 would be 18,199,000 tons, up 1.47% from 1988.
2. Excludes exports (which fluctuate around 10,000 tpy.)
Source: American Paper Institute.

in November 1990 that the revised rules could have a number of important implications for the industry. Basis weights could decline 10% to 20% over a period of time. New grades of containerboard will be developed in a wider range of basis weights. Board will be ordered in terms of compression—for example, 20/67 would be the STFI and ring crush equivalents of 42-lb linerboard. There will still be basis weights, Driscoll noted, but they will probably be in clusters—for example, around 40 lb, ranging from 37 to perhaps 43 lb. This will complicate containerboard trading among producers to reduce freight costs, as well as inventory maintenance. He said the change could initially reduce industry capacity as new grades are developed and as machines are modified to run to compression instead of mullen strength. But in the longer run, the revised rules could increase industry capacity in square footage while reducing it in terms of tonnage. The change would also encourage the industry trend to increased use of recycled and hardwood fiber. "Perhaps the major incentive for our industry is this opportunity to innovate and build a better mousetrap," Driscoll said. "No longer must everybody manufacture to the same basis weights. It may well be that the new rule could bring about a very welcome type of competition in the industry based on product differentiation."

If high-performance grades gain wider acceptance among box plants and their customers, linerboard basis weights could decline by as much as 10% to 20%, according to a recent study by Coleman Rowland of Lakeway Research. This could cause U.S. linerboard production to decline on a tonnage basis by as much as 1.0 million tpy over the next five years. Nevertheless, Rowland found that some box plant managers had reservations about shifting to the new grades. Many of them said their customers lack understanding of the new edge crush test. In addition, many also cited problems involving trim, scheduling, minimum order size, and inventory control. Many also said they were wait-

continued

(000 short tons)

RECYCLED			TOTAL LINERBOARD				
Capacity		Operating rate	Production		Capacity		Operating rate
Tonnage	Change (%)		Tonnage	Change (%)	Tonnage	Change (%)	
1,400a	27.3%	—	—	—	22,170	1.3%	—
1,100a	64.2	—	—	—	21,879	4.5	—
670a	48.9	—	—	—	20,941	4.4	—
450	12.5	74.2%	19,269	4.5%	20,061	2.4	96.1%
400	-1.7	97.0	18,445	0.8	19,592	2.5	94.1
407	-14.9	100.0	18,304	0.8	19,112	1.2	95.8
478	2.4	100.0	18,161	8.0	18,893	7.1	96.1
467	10.7	89.9	16,822	8.8	17,642	3.4	95.4
422	7.4	67.5	15,468	-4.8	17,062	0.6	90.7
393	-0.5	51.9	16,241	6.2	16,958	2.1	95.8
395	-10.2	73.2	15,296	11.1	16,612	0.8	92.1
440	-5.0	63.4	13,773	-7.3	16,472	4.0	83.6
463	-9.0	70.0	14,864	1.3	15,835	4.9	93.9
509	17.8	87.4	14,677	2.3	15,095	3.2	97.2
432	19.7	93.1	14,353	6.4	14,631	2.9	98.1
361	-7.9	70.9	13,484	4.4	14,225	1.8	94.8
392	8.6	87.0	12,914	3.0	13,978	1.2	92.4
361	-5.0	78.4	12,534	15.6	13,809	2.2	90.8
380	-11.6	54.5	10,842	-15.3	13,518	1.4	80.2
430	40.5	108.6	12,800	-0.2	13,331	1.2	96.0
306	-1.3	94.4	12,825	1.7	13,168	2.3	97.4
310	—	90.0	12,614	8.8	12,878	9.2	97.9
n.a.	—	—	11,590	3.0	11,797	0.5	98.2
n.a.	—	—	11,252	—	11,733	—	95.9

ing for new edge crush specifications to be finalized before promoting high-strength boxes made with high-performance containerboard.

Secondary fiber use. Unbleached kraft linerboard is made mainly from softwood trees (southern pine, Douglas fir, and eastern pines and spruces), but some mills have also traditionally used some hardwood species in the pulp furnish. In the past few years, the use of wastepaper fiber in kraft linerboard manufacture has also grown, from 4% of total fiber furnish in the late 1970s to around 13% current-

MONTHLY CONTAINERBOARD INVENTORY AT U.S. BOX PLANTS AND MILLS

(000 short tons/weeks of supply*)

	1991**		1990		1989		1988		1987	
Month	Tons	Weeks	Tons	Weeks	Tons	Weeks	Tons	Weeks	Tons	Weeks
Jan. 1	2,761	5.9	2,589	5.9	2,553	5.4	2,486	5.7	2,238	6.0
Feb. 1	3,091	6.3	2,678	5.7	2,707	5.6	2,663	5.7	2,340	5.6
Mar. 1	3,103	6.7	2,553	5.6	2,612	5.8	2,584	5.8	2,391	5.4
Apr. 1	2,997	6.5	2,621	5.8	2,569	5.7	2,513	5.7	2,414	5.6
May 1	2,877	5.9	2,587	5.2	2,564	5.1	2,552	5.1	2,375	5.2
June 1	2,583	5.8	2,538	5.5	2,495	5.5	2,595	5.9	2,383	5.6
July 1	2,634	5.3	2,500	5.3	2,475	5.5	2,617	6.0	2,385	5.4
Aug. 1	2,781	5.3	2,647	5.5	2,687	5.5	2,723	5.9	2,497	5.6
Sept. 1	2,682	5.3	2,617	5.6	2,664	5.8	2,731	6.2	2,437	5.5
Oct. 1	—	—	2,563	4.9	2,642	5.5	2,672	5.8	2,421	5.2
Nov. 1	—	—	2,481	4.8	2,460	4.9	2,519	5.0	2,352	5.0
Dec. 1	—	—	2,530	5.3	2,449	5.2	2,487	5.3	2,396	5.7

	1986		1985		1984		1983		1982	
Month	Tons	Weeks	Tons	Weeks	Tons	Weeks	Tons	Weeks	Tons	Weeks
Jan. 1	2,549	7.1	2,882	8.4	2,437	7.2	2,584	8.9	2,729	9.4
Feb. 1	2,502	5.7	2,970	7.4	2,408	6.0	2,485	7.1	2,482	7.5
Mar. 1	2,489	6.1	2,955	7.7	2,467	6.4	2,462	7.2	2,468	7.3
Apr. 1	2,518	6.2	3,023	8.0	2,448	6.4	2,414	6.8	2,570	7.4
May 1	2,438	5.5	2,987	7.3	2,512	6.2	2,495	6.9	2,656	7.6
June 1	2,394	6.1	2,945	7.6	2,541	6.5	2,463	6.8	2,671	8.1
July 1	2,320	5.5	2,838	7.5	2,659	7.1	2,511	6.8	2,650	7.9
Aug. 1	2,389	5.7	2,821	7.3	2,767	7.2	2,486	7.4	2,595	8.3
Sept. 1	2,344	5.8	2,694	7.0	2,711	7.0	2,421	6.6	2,553	7.5
Oct. 1	2,269	5.2	2,560	6.1	2,702	6.9	2,339	6.0	2,393	6.5
Nov. 1	2,181	4.8	2,492	5.8	2,602	6.2	2,302	5.8	2,424	6.9
Dec. 1	2,134	5.3	2,469	6.6	2,650	7.1	2,415	6.5	2,524	7.6

	1981		1980		1979		1978		1977	
Month	Tons	Weeks	Tons	Weeks	Tons	Weeks	Tons	Weeks	Tons	Weeks
Jan. 1	1,984	6.2	1,979	6.2	1,961	5.8	2,437	7.2	2,507	8.0
Feb. 1	1,960	5.5	1,991	5.3	1,825	5.1	2,297	7.0	2,376	7.8
Mar. 1	2,029	5.6	1,905	5.4	1,807	5.1	2,242	6.6	2,393	7.7
Apr. 1	2,104	5.7	1,890	5.4	1,789	5.0	2,208	6.1	2,412	7.5
May 1	2,232	5.9	2,021	5.7	1,846	4.8	2,179	6.4	2,463	7.4
June 1	2,298	6.7	2,119	6.5	1,856	5.2	2,155	6.0	2,513	7.5
July 1	2,368	6.7	2,248	7.0	1,863	5.3	2,169	6.1	2,577	8.0
Aug. 1	2,371	6.9	2,291	7.3	1,939	5.5	2,206	6.6	2,581	8.3
Sept. 1	2,376	6.9	2,225	7.1	1,945	5.6	2,119	6.0	2,613	8.0
Oct. 1	2,451	6.6	2,101	5.8	1,938	5.3	2,004	5.5	2,457	7.2
Nov. 1	2,437	7.1	1,880	5.6	1,877	4.8	1,923	5.1	2,439	7.1
Dec. 1	2,602	7.9	1,836	5.5	1,953	5.5	1,939	5.6	2,442	7.2

*Obtained by dividing inventories by average weekly usage in corrugated box plants during prior month, excluding holidays.

**Preliminary.

Source: Fibre Box Assn.

ly. The principal wastepaper grades used are old corrugated containers (OCC) and new double-lined kraft cuttings (NDLK). Usage varies, but the maximum amount of wastepaper consumed by any kraft linerboard mill is generally not over 25% of total fiber furnish.

A few U.S. mills produce linerboard from 100% wastepaper on either fourdrinier or multi-ply cylinder machines. This grade, called test linerboard, is typically produced in heavier basis weights. Currently, recycled linerboard supplies about 3% of total domestic linerboard demand. Test liner has traditionally filled the gap when kraft linerboard is in short supply, which occurred in both 1980 and 1987, when production jumped to nearly 500,000 tons. In both cases, production declined the following year as the kraft linerboard supply/demand equilibrium was reestablished.

The main motivation for building recycled linerboard capacity is the low capital cost of new mill construction—equivalent to approximately $250,000/daily ton of capacity, vs about $400,000/daily ton of capacity for construction of a new greenfield kraft linerboard mill. In addition to lower capital cost, such mills can be built on a smaller scale, making them easier for new industry participants (such as independent box converters) to finance. Also, consumer interest is growing in buying corrugated containers with a high secondary fiber content as a way of demonstrating concern about the environment and solid waste problem. In addition, government regulations and tax incentives are being used to promote wastepaper recycling.

Another attraction is the availability of low-cost fiber near major metropolitan areas of the Northeast, Midwest, and West Coast.

As a result, a growing number of linerboard projects are being planned based mainly on secondary fiber. Temple-Inland Inc. constructed a new 175,000-tpy recycled linerboard mill in Ontario, Calif., in 1985—the first such facility to be built in the U.S. using modern recycling technology.

Inland is now building a 215,000-tpy recycled linerboard mill in Maysville, Ky., for completion in 1993. Total cost of the mill (which can be expanded from 600 tpd to 775 tpd in capacity and which will buy steam from an adjacent utility power plant) is $176 million. The new mill will incorporate all of the latest technology, including multi-ply forming on the paper machine, caustic soaking to loosen contaminants, and fine-particle removal.

Two existing containerboard machines were converted to 100% recycled linerboard production in 1991, and another major machine conversion will be completed by Stone Container in mid-1992. Several new greenfield recycled linerboard mills are under study (see Capacity section in this chapter). All of these new projects, however, are raising some concern about whether or not enough OCC will be available at a reasonable price to supply all future domestic consumption plus rising export demand. The U.S. recovery rate for OCC, already slightly above 50%, could rise to 63% in 1995, according to Franklin Associates. And some consultants estimate the rate could climb to the 70% to 80% range as prices rise. While enough OCC and NDLK may not be available, some mills are beginning to experiment with the use of other types of wastepaper fiber. Green Bay Pack-

RATIO OF U.S. CONSUMPTION OF PAPERBOARD TO CORRUGATED CONTAINER PRODUCTION

CORRUGATING MEDIUM TONNAGE FOR CONTAINERS

Year	Consumption by box plants (000 short tons) Liner-board	Corrugating medium	Ratio (liner/medium)
1990	16,242	7,691	2.11
1989	16,037	7,488	2.14
1988	15,751	7,317	2.15
1987	15,276	7,086	2.16
1986	14,414	6,689	2.15
1985	13,605	6,247	2.17
1984	13,461	6,177	2.18
1983	12,594	5,768	2.18
1982	11,751	5,337	2.20
1981	12,262	5,530	2.22
1980	12,019	5,427	2.21
1979	12,456	5,654	2.20
1978	12,168	5,495	2.21
1977	11,318	5,103	2.22
1976	10,782	4,844	2.22
1975	9,609	4,320	2.22
1974	10,621	4,746	2.24
1973	11,315	5,060	2.24
1972	10,429	4,698	2.22
1971	9,465	4,273	2.22
1970	9,079	4,107	2.21

LINERBOARD TONNAGE FOR CONTAINERS

Year	Corrugator production (billion ft²)	Linerboard consumed by box plants (000 tons)	Ratio (1,000 ft²/ton)
1990	343.0	16,242	21.118
1989	336.3	16,037	20.970
1988	329.4	15,751	20.913
1987	318.5	15,276	20.850
1986	302.0	14,414	20.950
1985	284.8	13,605	20.933
1984	282.0	13,461	20.949
1983	264.2	12,594	20.980
1982	246.3	11,751	20.960
1981	253.0	12,262	20.633
1980	251.9	12,019	20.958
1979	261.1	12,456	20.962
1978	256.4	12,168	21.072
1977	238.8	11,318	21.099
1976	227.8	10,782	21.128
1975	203.2	9,609	21.147
1974	224.1	10,621	21.100
1973	238.5	11,315	21.078
1972	220.1	10,429	21.105
1971	200.3	9,465	21.162
1970	192.7	9,079	21.225
		Average:	21.020

Source: Based on data from Fibre Box Assn.

aging Inc., for example, is experimenting with the use of mixed office papers and newsprint for the top ply of linerboard grades offering white and gray surfaces for improved graphic quality.

Graphic display. Most U.S. linerboard is unbleached, but grades with a solid white or mottled white printing surface are growing in importance. Currently, they account for about 8% of total production. This reflects the growing use of corrugated containers for point-of-purchase displays in retail outlets. The most common grade for this application is mottled white linerboard, in which a thin layer of bleached fiber is added to the top of an unbleached sheet for a swirled effect. Production of mottled white board in 1990 totaled more than 1.26 million tons, and it has grown 7% to 8%/year over the past decade. This compares with a slightly better than 2% average annual growth rate for regular unbleached kraft over the same period. The largest producers are Container Corp. of America and St. Joe Paper Co., followed by Green Bay Packaging and Chesapeake Corp. Through most of 1991, production of mottled white was running about 2.7% ahead of the previous year, probably reflecting curtailment of capacity at two mills.

A higher-quality, more expensive alternative is solid bleached linerboard. Production of this grade in 1990 for the domestic market totaled 139,000 tons, and it has grown at a 4% to 5%/year rate over the past decade. However, production will probably drop off in the future due to lower-cost alternatives, which will be discussed subsequently. Temple-Inland is believed to be the largest supplier of solid bleached linerboard, followed by Georgia-Pacific and International Paper.

FACTORS FOR CONVERTING PRICES FROM $/TON TO $/1,000 FT^2, AND FROM $/1,000 FT^2 TO $/TON

Basis weight (lb/1,000 ft^2)	FACTOR 1 $/1,000 ft^2 to $/ton	FACTOR 2 $/ton to $/1,000 ft^2
26*	76.92	0.01300
31*	64.52	0.01550
33*	60.61	0.01650
36*	55.56	0.01800
38	52.63	0.01900
42	47.62	0.02100
47	42.55	0.02350
69	28.98	0.03451
90	22.22	0.04500

To convert the price per 1,000 ft^2 to equivalent price on a per-ton basis, multiply the price by FACTOR 1. For example, if the price of 33-lb linerboard is $4.79/1,000 ft^2, multiply $4.79 by 60.61. The price per ton is $290.

To convert the price per ton to equivalent price per 1,000 ft^2, multiply price by FACTOR 2.

*Corrugating medium weights. Linerboard is normally produced at 26, 33, 38, 42, 47, 69, and 90 lb/1,000 ft^2.

A third alternative is the use of clay-coated unbleached kraft board in the preprint process (see Coated and Uncoated Kraft Paperboard chapter and Converted Paper and Board Products chapter). Use of such coated board is believed to be small because preprint has been slow to develop high-volume applications and because supply is limited. More clay-coated board for linerboard applications has become available with the startup of Mead Corp.'s 420,000-tpy, clay-coated kraft board machine in fall 1990.

In late 1989, Chesapeake introduced a white-top linerboard grade that it hopes will open the high-volume end of the high-quality graphics market for preprint. Green Bay Packaging in 1990 came out with a white-top sheet made from recycled white paper. Inland Container Corp. is rebuilding a machine at its Orange, Texas, mill to produce 500 tpd of white-top board (using bleached pulp from its nearby Evadale, Texas, mill). Production of such white-top and coated kraft grades is expected to grow rapidly in the U.S. over the next five years. (Detailed information on these changing quality trends is available in *Growing Linerboard Specialties: White Grades and High-Performance Grades*, written by Coleman Rowland and published by Pulp & Paper Forecaster Services.)

Multi-ply forming. The need for linerboard with higher cross-machine strength (measured by ring crush) and better printing surfaces led to growing interest in multi-ply linerboard forming. Beyond the traditional fourdrinier and secondary headbox, some U.S. companies are adding top-wire dewatering units or mini-fourdriniers to produce two- or three-ply sheets. Willamette Industries Inc. recently added Bel Bond formers to all of its linerboard machines, and several other companies are planning similar installations. Georgia-Pacific recently rebuilt its No. 2 machine with an Escher Wyss top-former fourdrinier to produce a two-ply board. In 1985, Chesapeake's West Point, Va., mill started up a new Voith machine with four forming sections to produce a three-ply sheet.

These machines can use different fiber furnishes and

CURRENT LINERBOARD GRADE STRUCTURE*

Basis weight (lb/1,000 ft^2)	Grade distribution (%)
26	4%
33	12
38	4
42	50
47	1
69	22
90	3
other	4

*For domestic use.
Source: Fibre Box Assn., 1988.

also produce partially bleached grades, such as white-top or mottled board. Low cross-machine variation in basis weight and moisture profile is important for high-speed converting.

High-pressure presses. Companies are installing high-impulse or wide-nip presses to add incremental capacity and improve sheet strength. High-impulse presses make use of higher-than-usual linear press loadings—typically 1,000 to 2,000 psi or greater—as well as double felting and a nip width of 3.0 to 3.5 in. Wide-nip presses (such as Beloit's Extended Nip Press) usually increase nip pressure in the press section by passing a sheet between a single-grooved press roll opposed by a stationary loaded shoe. Pressure equivalent to 4,500 to 6,000 pli can be achieved because of the longer dwelltime of the sheet in the double-felted press (with nips ranging up to 10 in.).

The increased pressure can reduce steam requirements per ton in the dryer section by as much as 15% to 25%. It can also boost incremental capacity by 10% to 15% or more. Dryness of the sheet leaving the press can be raised to over 50%, and some mills are installing tandem high-intensity or wide-nip press sections to achieve after-press dryness levels approaching 60%. Wide-nip presses also increase sheet strength or permit mills to use more secondary or hardwood fiber while maintaining the same strength level.

Weyerhaeuser Paper Co. mills in Springfield, Ore., and Plymouth, N.C., pioneered the installation of Beloit's Extended Nip Press on linerboard machines in the early 1980s. Several other companies have since installed high-impulse or wide-nip presses, and suppliers other than Beloit have developed presses that achieve similar results. In a project completed in mid-1989, International Paper became the first U.S. producer to install a double wide-nip press (Voith Flex-o-Nip) at its Vicksburg, Miss., mill. Gaylord Container Corp.'s new machine at Bogalusa, La., and Union Camp's new machine at Savannah, Ga., are equipped with multi-ply forming sections and two Extended Nip Presses.

MARKET STRUCTURE

The U.S. linerboard industry in 1990 produced 18.9 million tons of kraft linerboard, of which about 2.5 million tons were exported, according to API statistics. (As previously noted, the industry also produced 340,000 tons of recycled linerboard and 139,000 tons of solid bleached linerboard.) The U.S. linerboard industry has a fairly high degree of integration, with roughly 70% of production transferred by companies to their own box plants or swapped with other producers to save on freight costs. About 15% of production is sold by producers to independent corrugated converters, and the remaining 12% to 15%

CAPACITY RANKINGS OF U.S. LINERBOARD PRODUCERS

(000 short tons)

	Company	Annual capacity Kraft	Recycled	Total	Capacity share (%)
1.	Stone Container	2,925[1]*	—	2,925	13.7%
2.	Georgia-Pacific	2,225	—	2,225	10.4
3.	International Paper	1,760	—	1,760	8.3
4.	Jefferson Smurfit/CCA	1,610*	—	1,610	7.6
5.	Union Camp	1,600[2]	—	1,600	7.5
6.	Temple-Inland	1,325*	200	1,525	7.2
7.	Weyerhaeuser	1,500*	—	1,500	7.0
8.	Gaylord Container	875[3]	350	1,225	5.8
9.	Packaging Corp. of America	1,160[4]	—	1,160	5.4
10.	Willamette Industries	900	—	900	4.2
11.	Westvaco	620	—	620	2.9
12.	Green Bay Packaging	350*	270[5]	620	2.9
13.	Macon Kraft	560[6]	—	560	2.6
14.	St. Joe Paper	490*	—	490	2.3
15.	Longview Fibre	480	—	480	2.3
16.	MacMillan Bloedel	445	—	445	2.1
17.	Boise Cascade	430	—	430	2.0
18.	Champion International	390	—	390	1.8
19.	Chesapeake	335*	—	335	1.6
20.	Interstate Resources	275	—	275	1.3
21.	Simpson Paper	235*	—	235	1.1

U.S. capacity (1991 year end): 21.303 million tons
Unbleached kraft: 20.540 million tons
Recycled linerboard: 763,000 tons
Capacity share of top five companies: 47.5%
Capacity share of top ten companies: 76.7%

* Includes mottled or white top linerboard.

[1] Includes all of Stone Container's 85%-owned Seminole Kraft Corp. mill in Jacksonville, Fla. (350,000 tpy liner capacity), which will be converted to recycled in mid-1992. Excludes linerboard capacity in Canada (216,000 tpy), Europe, and Mexico.

[2] Reflects total capacity from new machine at Savannah, Ga., mill (March 1991 startup).

[3] Reflects shutdown of kraft linerboard machine (195,000 tpy) at Antioch, Calif., mill.

[4] Includes Valdosta, Ga., linerboard mill sold by Georgia-Pacific Corp. to PCA/GE Capital in early 1991.

[5] Reflects conversion of semichemical medium machine at Green Bay, Wis., mill to recycled linerboard in early 1991.

[6] One machine produces board with high recycled content.

is exported overseas. A small amount of linerboard also finds its way into miscellaneous uses, such as tube, can, and core stock (although this "other" unbleached kraft paperboard is generally excluded from the statistics in this chapter, as is folding boxboard).

The two main determinants of linerboard demand are domestic corrugated box production and linerboard export shipments. In turn, corrugated box shipments closely track U.S. industrial production, and over the past decade (1981-90), they grew at a 2.9% average annual rate. Unbleached kraft linerboard production during the same period grew at a 2.6%/year rate. Linerboard exports were relatively flat over most of this period but, helped by the weak dollar, began climbing sharply in 1988-91. Exports in 1990 hit a record of 2.92 million short tons, exceeding the unusually high spike of 2.5 million tons achieved in 1980, based on Dept. of Commerce (DOC)-shipment figures (which differ from those of API). Exports (using API figures) as a percentage of total production in 1991 will average about 15%, up from a low of 12% in 1985, when they were hurt by the strong dollar, but below the 16.7% level attained in 1980, when People's Rep. China made large initial purchases of U.S. linerboard. Future growth in linerboard exports should outpace domestic consumption because of growing demand from Far East markets and the favorable cost position of U.S. linerboard producers.

Linerboard prices tend to be highly cyclical, usually rising during the middle and later stages of an economic recovery but falling when demand weakens and producers fight for business to keep their capital-intensive mills running. Pricing tends to be strongest when operating rates are around 95% or higher and when inventories are below about 5.5 weeks of supply; however, market psychology is an important factor. Normally, linerboard prices tend to push up corrugated container prices. Containerboard raw materials account for about 50% to 55% of the cost of making a corrugated container.

In market downturns, prices sometimes drop nearly to variable manufacturing costs (including delivery). The largest cost factor in producing linerboard is wood, which accounts for about 36% of total manufacturing costs (including interest and depreciation). Labor accounts for 13% of total costs, followed by energy (8% to 9%) and chemicals (5%). Domestic delivery costs average about $30 to $35/ton, while delivery costs are about $40 to $50/ton to Europe and about $55 to $70/ton to the Far East.

CURRENT MARKET CONDITIONS

The U.S. linerboard market appears to have begun to recover from the 1990-91 recession faster than most segments of the paper industry. The main reasons for this appear to be as follows: 1) a stronger recovery for U.S. manufacturing activity than for the economy as a whole, which is being held back by a major restructuring of the service and financial sectors, 2) high export demand for U.S. linerboard, which is very competitive due to the weak dollar, and 3) limited future capacity expansion in response

U.S. LINERBOARD INDUSTRY CONSOLIDATION

			Capacity of assets (000 tons)		
Year	**Acquiring company**	**Selling entity**	**Unbleached[1]**	**Total capacity**	**Price (million $)**
1991	PCA/GE Capital[2]	Georgia-Pacific (two mills, 19 box plants)	830	830	$740[3]
1990	Georgia-Pacific	Great Northern Nekoosa	962	3,530	3,740
1988	Gaylord Container	Louisiana-Pacific (Antioch mill)	247	247	156
1987	Great Northern Nekoosa	Owens-Illinois (Forest Products Div.)	1,040	1,040	1,170
1987	Pratt Holdings	Georgia Kraft (Macon mill)	525	525	272[3]
1987	Stone Container	Southwest Forest Industries	440	960	766
1986	Mid-America Packaging	Crown Zellerbach (Gaylord Container)	716	716	260
1986	Stone Container	Jacksonville Kraft	490	490	112
1986	Jefferson Smurfit	Mobil (Container Corp. subsidiary)	1,270	1,903	1,139[3]
1986	Temple-Inland	Owens-Illinois (Orange mill and box plants)	400	400	228[3]
1986	Stone Container	Champion International (Brown Systems Group)	1,027	1,027	426
1985	Mid-America Packaging	Weyerhaeuser (Pine Bluff mill)	112	112	28
1985	Simpson	Champion International (Tacoma mill)	288	372	27
1984	Boise Cascade	Sonat (remaining 50% interest in Boise Southern)	340	652	195[3]
1984	Georgia-Pacific	St. Regis (Monticello mill and box plants)	578	578	375[3]
1983	Stone Container	Continental Group (Brown Systems Group)	1,315	1,315	509
	Total acquisitions completed and pending—16 transactions		10,580[3]	14,697	10,143[3]

1. Includes linerboard, corrugating medium, and kraft paper.
2. GE Capital would buy mills and lease them to Purchasing Corp. of America.
3. Includes timber assets.
Source: Morgan Stanley & Co., *Pulp & Paper*.

to recent poor industry profitability plus some unexpected production curtailments.

The linerboard market appeared to stabilize in summer 1991, and producers were able to push through a $30/ton price increase in September, which took transaction prices in the eastern U.S. to about $350/short ton and to about $370 to $380 in the West (for 42-lb linerboard). This price was less than list levels of $380 in the East and $390 in the West announced in August by most producers, but it was a major sign that the market had begun to turn. If the industry is successful in pushing the increase through in finished box prices, another attempt will probably be made in first-quarter 1991 to raise transaction prices in the East back to the $380 level or even higher.

The major factor behind the recovery was probably a gradual pickup in U.S. corrugated box cut-up beginning in second-quarter 1991, reflecting a similar upturn in industrial production. U.S. corrugated box shipments (in square ft) compared with a year ago showed no growth in fourth-quarter 1990, declined 3.8% in the first quarter of 1991, and dipped 0.4% in the second quarter. Shipments for the third and fourth quarters of 1991, however, are expected to be up 3% to 4% from year-ago levels and to continue that growth in 1992.

U.S. export linerboard demand remained remarkably strong through the downturn in domestic demand due to the weak dollar and continuing economic growth in Europe and Asia. U.S. linerboard exports for first-half 1991 were running nearly 16% ahead of a year ago at an annual rate of nearly 3.5 million shorts tons, based on DOC statistics. This followed a 17% jump in shipments to a record 2.92 million tons in 1990.

The strong export demand was expected to offset a modest decline in domestic linerboard consumption, resulting in about a 1.2% increase in total U.S. linerboard production in 1991. With unbleached kraft linerboard capacity expected to increase about 2.5% in 1991, operating rates for kraft linerboard mills were expected to decline to around 95% from 96.6% in 1990. The jump in capacity reflected the startup of two new machines at Gaylord Container and Union Camp between June 1990 and March 1991.

Helping offset the new supply were a large number of mill curtailments for inventory reduction (mainly in first-half 1991), machine rebuilds, and maintenance. Two shutdowns were particularly notable: Gaylord Container indefinitely idled a 400-tpd linerboard machine (as well as a medium machine) at its Antioch, Calif., mill in February due to weak market conditions, high wood costs, and operational problems, and Stone Container expected to curtail about 600 to 700 tpd of production at its Missoula, Mont., mill for about eight months following a boiler explosion in May.

All of these factors contributed to a gradual firming of the market that was reflected in containerboard inventories

MAJOR U.S. LINERBOARD EXPANSION PROJECTS

Company	Mill location	Capacity (000 short tpy)	Startup date
Announced/completed			
Temple-Inland	Orange, Texas	90K	1989
	Rome, Ga.	176K	1990
Gaylord Container	Antioch, Calif.	110R[1]	1990
	Bogalusa, La.*	350K	1990
Georgia-Pacific	Cedar Springs, Ga.	60K	1990
Gaylord Container	Antioch, Calif.	(140K)[1]	1991
Green Bay Packaging	Morrilton, Ark.	125K	1990
Union Camp	Savannah, S.C.	165K[2]	1991
Green Bay	Green Bay, Wis.	270R[3]	1991
Willamette	Campti, La.	55K	1991
Jefferson Smurfit	Jacksonville, Fla.	90K	1991
	Fernandina Beach, Fla.	215K[4]	1991-92
Temple-Inland	Ontario, Calif.	60R	1991-92
MacMillan Bloedel	Pine Hill, Ala.	60K	1991-92
Temple-Inland	Orange, Texas	30K[5]	1992
Lin Pac	Gaffney, S.C.*	90R[6]	1992
Seminole Kraft	Jacksonville, Fla.	(350K)[7]	1992
		420R[7]	1992
Temple-Inland	Maysville, Ky.*	215R	1993
Weyerhaeuser	Valliant, Okla.	65K	1993
	Springfield, Ore.	55K	1994
Proposed			
Westfield Containerboard	Westfield, N.Y.*	300R[8]	1994
Daishowa/Trans-Rim	Stockton, Calif.	350R	n.a.

*New mills.
K = Kraft.
R = Recycled.
n.a .= Not available.

[1] Incremental tonnage from rebuild of machine (1990) converted to 100% recycled with shutdown of kraft pulp mill and another machine (1991).

[2] Net capacity after installation of new 460,000-tpy machine and shutdown of two older machines (one made kraft paper).

[3] Conversion of machine from semichemical medium to recycled linerboard.

[4] Reactivation of idle machine.

[5] Machine being rebuilt to produce 500 tpd of white top.

[6] Mill may produce some recycled medium or bag paper.

[7] Conversion from kraft to recycled linerboard and paper.

[8] Project backed by Domtar Inc. and group of independent box converters; site moved from Dunkirk, N.Y.

at box plants and mills, which dropped from a high of 2.1 million tons at the end of January (equal to 6.7 weeks of supply) to 2.68 million tons (5.3 weeks) by the end of August, according to Fibre Box Assn. statistics.

How 1990-91 downturn began. Corrugated box demand began to slow in 1989, and for the year, shipments (square ft) were up only 1.6% from the previous year. Linerboard producers in spring 1989 were unable to push through another $30/ton price increase, which would have taken the eastern U.S. price to a new high of $440/ton. In addition to sluggish box demand, the failure of the spring price increase also reflected new supply entering the market from a large number of incremental expansion projects as well as weakness in linerboard export markets. This caused some easing in mill operating rates, and growing discounting off the $410 list price was seen later in the year.

Corrugated box shipments remained sluggish in 1990 as a recession took hold in the U.S. economy around August. Price discounting continued to grow in the first half of the year, and by June, transaction prices for linerboard had dropped to around $360 to $370/ton—with even heavier discounting on corrugating medium. This price drop on containerboard caused some erosion in corrugated box prices. The linerboard market began to firm in the summer due to rising export demand, and U.S. containerboard inventories at the end of August dropped to a fairly normal level of 2.58 million tons (5.6 weeks of supply).

HISTORY OF EASTERN U.S. CONTAINERBOARD PRICES, 1940-72

($/short ton)

Effective date of price changes	Linerboard (42-lb)	Semichemical medium (26-lb)
Sep. 1, 1972	$130.00	$123.00
Oct. 1, 1963	127.50	120.00
Apr. 1, 1962	122.50	115.00
June 15, 1961	114.75	—
Mar. 15, 1961	—	106.00
Nov. 15, 1961	—	110.00
Nov. 1, 1960	—	119.25
Apr. 1, 1956	127.50	132.50
Sep. 1, 1953	122.50	127.50
Jan. 1, 1951	117.50	122.50
Nov. 1, 1950	112.50	117.50
Aug. 1, 1950	105.00	110.00
May 17, 1949	100.00	105.50
Feb. 1, 1948	105.00	—
Mar. 1, 1947	—	110.75
Feb. 1, 1947	100.00	100.00
Sep. 1, 1946	—	82.50
Apr. 1, 1946	74.00	—
Oct. 1, 1945	66.00	—
Jan. 1, 1944	—	77.00
Apr. 1, 1943	63.00	74.00
Jan. 1, 1943	—	68.50
Nov. 1, 1941	—	60.00
July 1, 1941	60.00	57.50
May 1, 1941	55.00	—
Apr. 1, 1941	—	53.00
Jan. 1, 1940	52.50	50.00

Source: *Pulp & Paper Pricebook.*

The relatively favorable market conditions, combined with cost pressure from the surge in oil prices (following the invasion of Kuwait), emboldened linerboard producers to announce a $30/ton price increase for Oct. 1, which would have taken the list price back to $410 in the eastern U.S. and $420 on the West Coast, which experienced intense pressure from rising wood costs. Integrated producers also announced about a 9.5% increase on corrugated boxes. In addition, U.S. producers announced a $30/metric-ton price increase on linerboard in most export markets.

The price increase fizzled, however, as the recession caused box shipments to weaken further and more new capacity began to start up. High mill production levels during the slow December holiday period caused containerboard inventories to jump to 2.81 million tons (6.6 weeks of supply) at the end of December. High inventories, sluggish domestic demand, and new capacity starting up caused prices to begin another downward spiral in first-half 1991. Prices bottomed out in late spring at around $320 to $330/ton in the eastern U.S. (before zone rebates). Prices of $310 and even lower were reported in the northeastern U.S., a particularly competitive market due to a high concentration of independent box makers and excess converting capacity resulting from a shrinking regional industrial base.

The decline brought prices down close to break-even levels for an average southern U.S. linerboard mill on a full cost basis (including interest and depreciation). The weak dollar, however, was probably a major factor in keeping prices from dropping close to variable cost levels, as they did in 1985. Profitability of major integrated producers held up somewhat better in the 1990-91 downturn because box prices tend to lag the decline in containerboard prices. From the peak in second-quarter 1989 to the trough in second-quarter 1991, linerboard prices declined 20.7% (from $410 to $325) and corrugated box prices dropped 9.1% (286.8 to 260.7 based on the Fibre Box Assn. index). On the West Coast, prices held up better at $340 to $350/ton, but most producers were reported to be losing money due to rising woodchip costs.

Strong dollar caused 1985 slump. The linerboard industry went into a deep slump in 1985 due to the strong U.S. dollar, which depressed U.S. linerboard export shipments. Linerboard exports dropped from 2.3 million tons in 1983 to a low of 1.8 million tons in 1985. Domestic demand was not strong enough to absorb the excess tonnage, and containerboard inventories at box plants and mills began to mount, hitting a record 3.0 million tons (8.0 weeks of supply) in spring 1985.

The price of linerboard dropped from a peak of $340/ton in fall 1984 to a low of about $250 to $260/ton in second-half 1985. Average mill net prices were even lower because of $10 and $20/ton zone rebates based on shipping distance from mills and because of abysmal export prices. Such

U.S. PRICES FOR UNBLEACHED KRAFT LINERBOARD

(42-lb eastern U.S.)

Year	$/short ton	$/1,000 ft²
1991		
4Qe	$350*	$7.35
3Q	320*	6.72
2Q	320/330*	6.72/6.93
1Q	350*	7.35
1990		
4Q	370*	7.77
3Q	370*	7.77
2Q	380	7.98
1Q	390	8.19
1989		
4Q	400*	8.40
3Q	400	8.40
2Q	410	8.61
1Q	410	8.61
1988		
4Q	410*	8.61
3Q	410	8.61
2Q	410	8.61
1Q	380	7.98
1987		
4Q	$380	7.98
3Q	350/380	7.35/7.98
2Q	350	7.35
1Q	350	7.35
1986		
4Q	320	6.72
3Q	310/320	6.51/6.72
2Q	280/290	5.88/6.09
1Q	260*	5.46
1985		
4Q	250/260	5.23/5.46
3Q	250/260	5.23/5.46
2Q	275	5.77
1Q	300/320	6.30/6.72
1984		
4Q	320/350	6.72/7.35
3Q	320	6.72
2Q	320	6.72
1Q	290/320	6.09/6.72
Year end		
1983	290	6.09
1982	250*	5.25
1981	270*	5.67
1980	270	5.67
1979	250	5.25
1978	220	4.62
1977	185*	3.89
1976	205*	4.31
1975	195	4.10
1974	195	4.10
1973	145	3.05
1972	130	2.73
1971	127.50	2.68
1970	127.50	2.68

*Indicates some discounting from transaction levels.

price levels were far below the estimated $270 to $290/ton break-even level for an average southern mill (including depreciation and freight). What helped limit the gush of red ink for many integrated producers was the fact that corrugated box prices eroded more slowly than linerboard prices. While linerboard prices declined by about 25% during this period, corrugated box prices eroded only about 12%.

Producers took heavy downtime in 1985 to bring supply into better balance with demand. Operating rates for the year averaged under 91%—down from 97% the preceding year. Demand began to improve in 1986, helped by the weakened dollar, which revived U.S. corrugated box shipments (up 6.2% for the year) and linerboard exports. Linerboard production in 1986 rose 8%, and export shipments surged 20% to nearly 2.2 million tons. Inventories of containerboard dropped back to 2.2 million tons (4.8 weeks of supply) by the end of 1986. Producers pushed through a $30/ton price increase to $290/ton in April and implemented another increase to $320/ton in the fall.

The market continued to tighten during the next year, with linerboard mill operating rates rising from 95% in 1986 to 97% in 1987. Prices rose $30/ton to reach $350/ton in January, followed by another increase to a new peak of $380/ton in August 1987. U.S. export shipments rose 5.4% to 2.3 million tons, and they were probably held back by linerboard availability. The strong market conditions contin-

Footnotes for kraft linerboard price table

Zoned discounts. The eastern U.S. transaction prices shown above are generally before zoned rebates based on shipping distance from mills (most of which are located in the South). These discounts have typically been about $10/ton in some parts of the Midwest and $20 in the South. Producers in recent years have been trying to maintain a $10/ton upcharge on prices in the West Coast to reflect higher woodchip and other costs. Industry list prices as of Aug. 1, 1991 were generally raised to $380 in the eastern U.S. and to $390 on the West Coast.

Basis weight differentials. Based on the 42-lb eastern list price of $380 ($7.98/1000 ft²), upcharges for other weights of standard unbleached kraft linerboard are about as follows (with some possible slight variation among producers):

Weight	$/ton	$/1,000 ft²
26 lb	$435	$5.66
30	410	6.15
33	410	6.77
38	385	7.32
64	380	12.16
69	380	13.11
90	390	17.55

Specialty grades. List price for for 42-lb mottled white is around $495/ton ($10.40/1,000 ft²). List prices for other weights are around $555 for 33 lb and $460 for 69 lb. Wet strength grades typically sell at a $10-to-$20/ton upcharge over standard unbleached kraft linerboard.

ued in 1988, with linerboard mills still running at full capacity. Producers implemented another $30/ton price increase to $410/ton in March 1988, which resulted in record industry profitability. The average southern mill had an estimated pretax profit of nearly $110/ton in 1988 (including depreciation and interest). This followed an essentially break-even performance by the industry during the first half of the decade, with losses in 1982-83 and 1985.

CAPACITY TRENDS

The recent drop in industry profitability is causing linerboard capacity growth to slow to a crawl. The December 1990 API capacity survey showed industry kraft linerboard capacity rising at a nearly 2.0%/year rate over the 1991-93 period (down from 3.5%/year over the 1990-92 period). Revised to reflect more recent announced changes, however, kraft linerboard capacity may show almost no growth over this period. With the inclusion of recycled linerboard capacity—which is expected to more than double over the next three years—total linerboard capacity would increase at only about 1.7% to 2.0%/year over the 1991-93 period.

Unbleached kraft linerboard capacity was originally expected to jump 3.4% in 1991, reflecting the startup of two new machines. Gaylord Container in July 1990 started up a new 350,000-tpy linerboard machine at its Bogalusa mill. In March 1991, Union Camp started up a 460,000-tpy lightweight linerboard machine, although the net capacity addition is expected to be about 165,000 tpy because of the shutdown of an older linerboard machine and a kraft paper machine. In addition, Jefferson Smurfit Corp. plans to reactivate a machine at its Fernandina, Fla., mill in fourth-quarter 1991, producing as much as 230,000 tpy of linerboard (but the machine may also produce some medium and will be based partly on recycled fiber).

However, Mead's new 375,000-tpy coated kraft board machine at Mahrt, Ala., which began production in September 1991, has produced only a small amount of linerboard due to strong demand for its primary boxboard grade. In addition, Gaylord Container in early 1991 indefinitely shut down one 150,000-tpy kraft linerboard machine as well as the medium machine and kraft pulp mill at Antioch. Meanwhile, some incremental expansion projects have been postponed at existing kraft linerboard mills, and no new machines have been announced.

Almost all of the growth will be in recycled linerboard capacity, which will jump from a small base of 450,000 tpy in 1990 to nearly 1.4 million tpy by 1993. This would include Green Bay Packaging's conversion of a semichemical medium machine at its Green Bay, Wis., mill to production of 270,000 tpy of 100% recycled linerboard in early 1991. Gaylord has shifted a recently rebuilt machine at its Antioch mill to 350,000 tpy of 100% recycled linerboard production (as part of the previously mentioned shut down of the kraft pulp mill there and two smaller machines). Stone Container is converting the kraft linerboard machine at its Seminole Kraft Corp. affiliate in Jacksonville, Fla., to production of 420,000 tpy of 100% wastepaper-based linerboard—the largest such facility in the world. Lin Pac Inc., a major independent converter, and several other partners are building a 90,000-tpy "mini" mill at Guffney, N.C., that will produce recycled containerboard and bag paper. And Temple-Inland is building a new 210,000-tpy recycled linerboard mill at Maysville for completion in early 1993.

Several earlier announced greenfield recycled linerboard projects continue to be studied. Some of these projects may get financing once linerboard prices begin to recover, and a probable result will be accelerated linerboard capacity growth in the mid-1990s. These projects include Westfield Containerboard, a new company formed by Domtar Inc. with about eight independent box converters. The partnership is studying a new 300,000-tpy recycled linerboard mill that would be built in Westfield, N.Y. (a town near Dunkirk, which was the original name and site for the project). Daishowa Paper Manufacturing Co. Ltd. of Japan, with a U.S. independent converter, has proposed building a 350,000-tpy containerboard mill in Stockton, Calif., using 100% wastepaper. Kenaf of North America Inc. earlier proposed construction of a 265,000-tpy recycled linerboard mill in Muskogee, Okla., but the project needs a new partner.

MANUFACTURING COST AND PROFITABILITY TRENDS FOR AVERAGE U.S. SOUTHERN LINERBOARD MILL

($/short ton)

	1991[1]	1990	1989	1988	1987	1986	1985	1984
Average price[1]	$341	$380	$405	$403	$361	$295	$274	$320
Fiber	126	120	114	107	103	98	106	113
Energy	27	25	23	23	24	24	32	34
Labor	39	38	37	36	36	36	35	35
Chemicals	17	16	15	14	14	14	15	15
Other	20	19	18	18	17	16	17	17
Delivery	37	36	34	33	32	32	32	32
Total variable costs	266	254	241	231	224	220	237	247
Depreciation	31	30	28	26	25	24	23	21
Interest	22	21	20	19	18	18	17	15
Overhead	18	18	17	16	16	16	15	15
Total costs[2]	337	323	306	292	283	278	292	299
Pretax profit[1]	4	57	99	111	78	17	(18)	21

Sources: 1. *Pulp & Paper* estimates. 2. Cost estimates from Resource Information Systems Inc. (RISI), World Kraftliner Study for 1984-89.

No new kraft mills. The era of constructing huge linerboard mills in the U.S. has passed because current linerboard prices are still below the level needed to justify the heavy investment required. In a 1989 speech, Roger W. Stone, chairman of Stone Container, estimated that it would cost $700 million to replace his company's 1,850-tpd linerboard mill in Florence, S.C. He said linerboard prices would have to be near $500/ton for the company to achieve a reasonable return on such an investment. The cost of the Florence mill converts to about $380,000/daily ton, vs about $250,000/daily ton for a recycled mill. Because of these economic considerations, several companies are studying the construction of new recycled linerboard mills or the upgrading of older kraft mills.

A popular incremental expansion strategy is the installation of high-impulse or wide-nip presses accompanied by a wastepaper recycling line or debottlenecking of the kraft recovery system. High-pressure presses can add as much as 10% to 15% or more incremental capacity to an existing machine, and they can be installed relatively quickly.

One reason for higher-than-normal linerboard capacity growth in recent years has been widespread installation of such high-pressure presses on existing linerboard machines. This has caused a faster-than-normal upward creep in the

EXPORTS OF KRAFT LINERBOARD BY MAJOR SUPPLYING COUNTRIES

(000 metric tons)

Country	1990	1989	1988	1987	1986	% change 1990/89
U.S.	2,653	2,268	2,070	2,083	1,975	17.0%
Sweden	1,107	1,138	1,146	1,085	1,008	-2.7
Canada	343	226	293	282	315	52.0
Finland	215	266	263	258	221	-19.0
Brazil	308	273	407	212	189	12.7
Portugal	170	161	120	114	135	6.0
France	163	151	125	125	n.a.	8.0
Austria	114	111	114	111	99	3.1
Norway	85	66	54	50	38	27.8
Spain	36	26	34	39	35	11.4
Total	**5,194**	**4,691**	**4,626**	**4,359**	**4,142**	**10.7**

n.a. = Not available.
Source: American Paper Institute—International Div., "Exports of Kraft Linerboard & Corrugating Material."

U.S. KRAFT LINERBOARD EXPORTS BY WORLD REGION

(000 metric tons)[1]

Year	Total[2]	Western Europe	Far East/ Oceania	People's Rep. China	Central America/ Mexico	South America	Caribbean/ other islands	Canada	Middle East	Africa
1990	2,653	763	633	191	418	244	61	64	167	112
1989	2,268	576	628	224	343	173	57	67	128	69
1988	2,070	554	600	144	330	120	58	41	140	85
1987	2,083	542	574	258	250	112	51	40	132	83
1986	1,975	577	559	165	240	118	62	38	129	79
1985	1,640	464	417	100	227	111	51	36	124	97
1984	1,868	646	449	100	291	123	60	34	130	100
1983	2,046	691	455	151	250	100	67	44	137	98
1982	1,711	584	338	101	240	121	49	44	102	135
1981	1,790	578	324	158	250	119	44	35	115	168
1980	2,293	834	373	289	306	118	42	24	90	219
1979	1,493	645	240	10	252	100	41	50	92	64
1978	1,397	565	181	3	245	132	65	35	97	73
1977	1,296	551	109	20	216	121	61	27	107	84
1976	1,288	561	105	—	213	83	57	66	102	101
1975	1,111	474	66	—	155	110	34	59	129	83
1974	1,582	841	105	5	185	126	47	37	97	136
1973	1,494	782	128	15	215	125	39	17	72	98
1972	1,703	974	138	—	221	124	53	17	90	87
1971	1,784	1,058	129	—	224	134	40	15	91	92
1970	1,598	922	94	—	216	134	36	17	86	92

1. Includes "bleached" linerboard exports of 100,000 to 150,000 tons in recent years (most of this is believed to be unbleached mottled board that has been misclassified).
2. Some variation exists between Dept. of Commerce and American Paper Institute linerboard export production and shipment figures.
Source: American Paper Institute (from Dept. of Commerce data).

KRAFT LINERBOARD vs TESTLINER PRICES IN EUROPE

Year	Kraft linerboard (175 g+) U.S.[1] ($/metric ton)	Kraft linerboard (175 g+) Nordic[2] (DM/metric ton)	Testliner No. 2 German[2] (DM/metric ton)
1991			
4Qe	$420/430*	DM850/900	DM650/680
3Q	420/430*	850/900	680/720
2Q	420/430*	880/900	700/750
1Q	420/430*	840/860	720/760
1990			
4Q	420/440*	840/860	710/750
3Q	420/440*	860/900	710/730
2Q	430/450*	1,150	770/800
1Q	440/460*	1,150	800/830
1989			
4Q	460/480*	1,150	800/830
3Q	480/490*	1,095/1,150	800/820
2Q	500	1,095	800/820
1Q	500	1,095	810/820
1988			
4Q	500*	1,095	790/820
3Q	515	1,025	750/780
2Q	530	1,025	640/720
1Q	485	990	660/680
1987			
4Q	485	990	650/670
3Q	485	990	650/670
2Q	440	960/970	640/660
1Q	405	930/965	610/630
1986			
4Q	405	960	620/650
3Q	370/405	1,025	660
2Q	370	940	700
1Q	290/310	—	700
Year-end			
1985	270/290	—	750
1984	370/405	—	890
1983	333*	—	720
1982	300*	—	670
1981	415	—	780
1980	380	—	750/925
1979	375	—	770
1978	280	—	560
1977	230*	—	—
1976	255*	—	—
1975	310*	—	—
1974	350	—	—
1973	245	—	—
1972	170	—	—
1971	137	—	—

*Some tonnage being sold below main transaction price levels.
1. c.i.f. basis, duty (currently 6%) unpaid.
2. Nordic and German prices are free-delivered and include DM60 for delivery.
175 g+ is heavyweight (36 lb+).
Source: *Pulp & Paper Week.*

U.S. industry's capacity base. For example, API's 1985 capacity survey projected total unbleached kraft paperboard capacity would reach 18.954 million tons by the end of 1988. The 1989 API survey estimated the figure at 20.269 million tons. Historically, industry capacity has risen about 300,000 to 400,000 tons during the four-year span from when capacity is first estimated to when it becomes the base year of a new forecast, API's Driscoll has noted. During the 1985-88 span, capacity creep turned into a surge, jumping 1.32 million tons.

Such rebuilds still have considerable growth potential since nearly half of the approximately 80 unbleached kraft board machines in the industry could still be equipped with these presses. These rebuilds could add more than 1.0 million tons to existing industry capacity. The remaining machines in the industry either have already had such presses installed or are believed to be unsuitable for such rebuilds. As previously noted, a number of mills are upgrading their machines by installing top formers to improve sheet quality. These projects also may add incremental capacity. About 17 U.S. linerboard mills recently had incremental capacity expansion projects under way that would each add 50,000 tpy or more of capacity during 1988-91.

Another potential source of additional linerboard capacity is the shift of swing machines away from kraft paper to linerboard production. The kraft paper market has declined since 1979 because of the penetration of plastic bags in the grocery sack market and sluggish shipments of multiwall sacks (see chapter on Packaging and Industrial Converting). Plastic bags have captured about 50% of the 25-billion-unit grocery bag market, and continued market penetration is expected. Unbleached kraft paper shipments have dropped from a peak of 3.93 million tons in 1979 to 2.38 million tons in 1990, a decline of 1.55 million tons.

The majority of that capacity was shifted to white paper production by such companies as Champion International Corp., International Paper, and Georgia-Pacific, and some was permanently shut down. Part of that capacity, however, was shifted to linerboard production. About 11 swing kraft paper/linerboard machines are still in operation, accounting for about 13% of kraft linerboard production and 30% of kraft paper production. Any conversion of this swing capacity to full-time linerboard production would add proportionally more linerboard capacity because capacity increases an estimated 20% when paper production is converted to linerboard. Stone Container in 1990 announced plans to produce about 100,000 tpy of lightweight linerboard on No. 5 machine at its Hodge, La., mill, which had been permanently dedicated to kraft paper.

Greater use of high-performance linerboard may increase industry capacity if machines are able to increase production (based on surface area). The alternate to Rule 41 adopted in early 1991 would permit the use of lighter-weight linerboard as long as it had the necessary compression strength. As noted earlier in this chapter, one study has estimated that the drop in basis weights could reduce U.S. linerboard production by as much as 1.0 million tpy over the next five years. However, some experts believe that industry capacity initially could be reduced as machines in the industry adjust to new standards based on compression strength rather than mullen.

INDUSTRY RESTRUCTURING

The U.S. linerboard industry went through a major period of consolidation during the 1980s—reflecting the merger mania of the decade. Some large, diversified companies (Continental Group, Owens-Illinois Inc., and Mobil Corp.) with minor, nonstrategic interests in the linerboard industry sold their operations. Other companies became available (St. Regis and Crown Zellerbach) because of attacks by corporate raiders. At the same time, some companies (Stone Container, Jefferson Smurfit, and Gaylord Container) used leveraged financing techniques to take advantage of low asset values and to significantly expand their positions in the linerboard industry.

According to Thomas P. Clephane of Morgan Stanley & Co., about 8.8 million tons of containerboard/kraft paper capacity changed ownership (31% of total industry capacity) in 14 transactions during the 1983-88 period. Stone Container's multiple acquisitions included Continental Group's linerboard/kraft paper operations for $509 million, most of Champion International's unbleached mills for $426 million, Jacksonville Kraft for $112 million, and Southwest Forest Industries for $766 million. Jefferson Smurfit and a Morgan Stanley investment group acquired Container Corp. of America from Mobil for $1.14 billion. And Gaylord Container acquired a kraft paper mill from Weyerhaeuser in 1985, the former Crown Zellerbach containerboard division in 1986, and Louisiana-Pacific Corp.'s Antioch mill in 1988 (currently shut down).

Some major established paper companies also expanded their positions in the industry. Great Northern Nekoosa Corp. significantly increased its level of integration with containerboard mills and box converting plants when it purchased Owens-Illinois' Forest Products Div. for $1.17 billion in 1987. Major mill purchases were also made during the decade by Georgia-Pacific, Boise Cascade Corp., Temple-Inland, and Simpson Paper Co.

The only major foreign company investment in the U.S. linerboard industry was Pratt Pty Holdings' purchase of the former Georgia Kraft Co. mill in Macon, Ga., for an estimated $272 million. The Australian company also acquired a number of box plants. The sale of the Macon mill was part of the dissolution of the Georgia Kraft joint venture between Temple-Inland and Mead. Temple-Inland purchased Georgia-Kraft's Rome, Ga., linerboard mill, and Mead purchased the Mahrt mill to focus on producing coated kraft board. Another Australian company, Amcor Ltd., however, acquired Sunclipse Inc., a major southern California converter (Corru Kraft) and paper distributor, in 1989.

Many of the acquisitions were made at extremely attractive prices. For example, the cost for Stone Container's acquisitions was $137,000/daily ton of capacity for the Continental Group operations and $147,000/daily ton for Champion's unbleached mills. Smurfit/Morgan Stanley paid $212,000/daily ton for Container Corp. of America. (These figures include timber, box plants, and other paper/board grades in the total purchase price.) Improving industry profitability caused asset values to rise in the late 1980s. Great Northern Nekoosa paid close to $400,000/daily ton for its later acquisition of O-I's Forest Products Div., but this also reflected the quality of assets involved.

As a result of improved market conditions and aggressive cost cutting, the acquisition strategy of companies such as Stone Container and Jefferson Smurfit paid off dramati-

U.S. EXPORT LINERBOARD PRICES IN ASIA

Year	Southeast Asia 125 g ($/metric ton c.i.f.)[1]	People's Rep. China ($/metric ton f.a.s.)[2]	Japan 175 g+ ($/metric ton c.i.f.)[3]	Japan Domestic K_2 (¥/kg delivered)[4]
1991				
4Qe	$480/510	$380	$420	¥75
3Q	480/510*	350	410	75
2Q	460/510*	350	400	75
1Q	460/490*	360	400	75
1990				
4Q	510	360	400	75
3Q	510	350	400	75
2Q	510	350	400	75
1Q	510	350	400	75
1989				
4Q	510	355	400/425	75
3Q	530	360	425	75
2Q	530/540	350	425	75
1Q	520/530	350	425	78
1988				
4Q	520/530	351	450	78
3Q	550/570	355	450	78
2Q	550/570	361	450	78
1Q	530	n.a.	n.a.	n.a.
1987				
4Q	530	422	450	¥80
3Q	500/530	391	420/450	80
2Q	500	367	420	80
1Q	485/500	358	390	78
1986				
4Q	440/455	332	380	75
3Q	420/435	308	370	80
2Q	350	219	350	85/87
1Q	280	203	320	85
Year end				
1985	270*	208	—	85
1984	380	326	—	124/125
1983	365	222	—	118/120
1982	—	207	—	119/129
1981	—	280	—	133/140
1980	—	326	—	137

e = Estimate.

1. Levels in Hong Kong typically $10/ton lower due to freight cost.
2. Average value per ton of exports calculated from Dept. of Commerce data.
3. Prices from regular U.S. suppliers.
4. K_2 contains about 40% wastepaper and has become the most important liner grade made by Japanese mills.

Source: *Pulp & Paper Week*.

cally. Smurfit estimated that it reduced CCA's expenses by $240 million in 1987-88. CCA's profit in 1988 reached about $128 million after taxes—up from only $30 to $40 million in 1984-85. From a break-even profit in 1985, Stone Container earned $342 million in 1988. In addition, Stone acquired a foothold in the Canadian and European containerboard and corrugated box markets with its $2.2-billion acquisition of Consolidated-Bathurst Inc. in early 1989. But this acquisition now looks like a mistake because of the sharp downturn of the newsprint market and the heavy debt load Stone incurred in the acquisition.

Merger activity has continued into the early 1990s with Georgia-Pacific's acquisition of Great Northern Nekoosa in spring 1990. G-P then announced plans to sell its linerboard mill at Valdosta, Ga., and its semichemical medium mill at Tomahawk, Wis., plus 19 box plants and some timberland for $740 million to Packaging Corp. of America and GE Capital. The mills would be sold to GE Capital, which would then lease them to PCA in what would be the largest such transaction ever.

Despite recent merger activity, the U.S. industry is still fragmented, with 21 individual linerboard producers. The five largest producers account for about 52% of U.S. linerboard capacity (vs 34% in 1980), and the ten largest have approximately 78% of the market (vs 58% in 1980). Stone Container, now the largest U.S. producer with a 14% market share, rose from No. 16 in 1980. Four new companies emerged among the ten largest producers during this time span, while six disappeared from the industry altogether.

The industry's level of integration probably has also increased in recent years as linerboard producers have tried to reduce their exposure to the cyclical board market by buying converting operations. Currently, the largest net sellers of linerboard to independent converters are International Paper, Georgia-Pacific, Union Camp, Stone Container, Macon Kraft Co., and Gaylord Container. Independent converters are in the difficult position of having to buy raw material from their competitors in the box market, but they survive by skillful purchasing and serving market niches.

WESTERN EUROPE'S KRAFT LINERBOARD SUPPLIERS

(000 metric tons)

	1990	1989	1988	1987	1986	1985
Sweden	1,036	1,028	1,062	1,012	939	944
Finland	195	237	250	230	205	176
Norway	84	63	53	41	32	17
Nordic	2,217	1,328	1,364	1,282	1,175	1,137
U.S.	763	576	554	542	577	464
Canada	139	116	142	126	121	95
Austria	112	107	110	106	93	86
Iberia	196	189	151	149	165	162
France	139	133	118	116	107	78
Brazil	234	179	279	169	142	98
U.S.S.R.	n.a.	n.a.	43	95	78	17
S. Africa	n.a.	n.a.	81	59	63	14

n.a. = Not available.

INTERNATIONAL MARKETS

The world linerboard market is estimated at around 42 million metric tpy—of which about 70% is kraft linerboard and the remainder recycled board. World kraft liner exports total more than 5 million tons annually, with the largest suppliers being the U.S., Sweden, Canada, Finland, and Brazil. Kraft linerboard exports compete with locally produced recycled test linerboard in Western Europe and Asia. Only about 40% of the linerboard consumed in Europe is kraft linerboard, while the remainder is test and other recycled board.

Supply/demand conditions in the large U.S. linerboard market have a major impact on price levels in the world linerboard market. This is because of the large size of U.S. industry, which in 1990 produced 17.4 million metric tons of linerboard and exported nearly 2.65 million tons. If the domestic market has excess supply, producers will try to boost export shipments if prices in overseas markets are favorable. This has the effect of taking some pressure off U.S. linerboard prices and, more importantly, protecting domestic box prices. However, the increased export activity—particularly by mills that are not regular suppliers—can wreak havoc on price levels in Western Europe and most Asian markets.

Export demand and exchange rate fluctuations can also have a major impact on the domestic linerboard market. Heavy initial purchases by People's Rep. of China in 1980 spiked total U.S. linerboard exports to a record 2.29 million metric tons and helped keep the domestic market in balance. In 1985, however, the strong dollar caused U.S. linerboard exports to slump to only 1.64 million tons. This contributed to an oversupply in the domestic market, which caused U.S. linerboard prices to collapse even though the U.S. economy was not in a real recession.

U.S. linerboard exports in 1990 rose 17% to 2.65 million metric tons, exceeding the record 2.29 tons exported in 1980, according to DOC statistics (which include some bleached linerboard). With the weak U.S. dollar and stronger economic growth in many overseas countries, U.S. linerboard exports continued to grow in 1991 and were expected to hit a new record of about 3 million metric tons, up 15% from 1990. This strong export performance has enabled the industry to weather the recent recession with relatively high operating rates.

Western Europe. Corrugated box shipments in Western Europe have been growing at a healthy 5% to 6% annual rate over the 1986-90 period, which is faster than industrial production. European kraft linerboard consumption rose to nearly 3.8 million tons in 1990, up 5% from the previous year. The weak dollar enabled U.S. suppliers to capture a larger share of this growing market in 1990, at the expense of higher-cost Nordic suppliers. While Nordic exports of kraft liner to Europe declined 1% to 1.3 million tons, U.S.

linerboard exports rose by almost one-third to 762,560 tons. U.S. suppliers increased their share of the European kraft liner import market to more than 26% in 1990 from about 22% the previous year, while Nordic suppliers saw their share shrink to 45% from more than 50%, according to the API export report.

Linerboard prices in Europe have been declining, partly due to inroads by competitively priced U.S. exports. After reaching a peak of about $525/metric ton c.i.f. (before 6% duty) in spring 1988, the price of heavyweight (175+ g) linerboard from U.S. suppliers gradually eroded down to about $420 to $430/metric ton by fall 1990 and then stabilized. This downturn was less severe than that experienced in 1985, when export prices dropped below the minimum antidumping level of $333/metric ton imposed by the European Community—which made it difficult for U.S. producers to compete on both economic and legal grounds.

As might be expected, local currency prices of Nordic and Continental kraft linerboard producers declined even more rapidly. From a peak of DM1,150/metric ton in first-half 1990, prices dropped to DM840 to DM860 (free delivered) by fourth-quarter 1990. With some strengthening in the dollar in early 1991, European producers were partially successful in pushing through a DM50/ton price increase in second-quarter 1990. Several U.S. producers announced a $30 to $40/ton price increase for fourth-quarter 1991, which would have taken their list prices for heavyweight liner to about $450 to $465/ton. But the increase was not supported by other U.S. and European producers, and it appears to be delayed until at least early 1992.

Despite recent slowing in demand, the outlook for European linerboard consumption should be relatively bright over the next five years. Growth in European corrugated box demand should be helped by higher growth rates resulting from political unification in 1992 and the opening of Eastern Europe. German corrugated box shipments in 1990 grew at the remarkable 10% rate. Per capita corrugated box consumption is considerably lower in Europe than in the U.S. (about 40 kg in Germany and France vs 80 kg in the U.S.), and changes in the European distribution will create more need for corrugated material for shipping over longer distances.

One future obstacle to the growth of U.S. kraft linerboard exports to Europe may be environmental legislation, such as Germany's "green dot" program, designed to increase recycling rates. This program requires that 80% of paper and board packaging in Germany be collected by 1995 and that 64% of this packaging be recycled. Reflecting such pressures, Svenska Cellulosa AB recently announced plans to produce some test liner at its large Obbola kraft linerboard mill in Sweden. Obbola could eventually produce 100,000 tpy of recycled linerboard.

European (including Nordic) kraft linerboard capacity is expected to rise at a 3.3%/year rate, from 2.77 million tons in 1989 to 3.1 million tons in 1993. Capacity for test linerboard will probably show somewhat higher growth, with the startup of several new machines and growing environmental interest in recycling. Production of display or white linerboard grades has been growing rapidly in Western Europe. Capacity of mottled and white-top linerboard is expected to grow from about 565,000 tons in 1989 to 785,000 tons in 1993—an 8.6% average annual rate, according to API.

Pacific Rim. The rapidly growing countries of the Far East and Oceania are becoming an increasingly important market for kraft linerboard exports. U.S. exports to Peo-

U.S. WHITE LINERBOARD PRODUCTION[1]

(000 short tons)

Year	Mottled/ white top	Change (%)	Solid bleached	Change (%)
1991e	1,295	2.8%	145	4.3%
1990	1,260	10.0	139	-21.9
1989	1,145	7.1	178	4.7
1988	1,069	-1.8	170	26.9
1987	1,089	14.9	134	1.5
1986	948	13.3	132	15.8
1985	837	2.8	114	-4.2
1984	814	15.3	119	3.5
1983	706	13.5	115	23.7
1982	622	-7.6	93	-7.9
1981	673	7.2	101	5.2
1980	628	—	96	—
Average annual growth rate, 1981-90		7.5%		4.7%

1. For domestic use; excludes exports.
Source: American Paper Institute, *Pulp and Paper* estimates.

U.S. UNBLEACHED KRAFT LINERBOARD PRODUCTION

(000 short tons)

Year	Domestic use	Change (%)	Export	Change (%)
1990	16,414	3.7%	2,521	13.4%
1989*	15,833	1.5	2,224	n.m.
1988	15,601	1.4	2,296	-0.3
1987	15,380	8.5	2,303	3.4
1986	14,174	6.1	2,228	21.7
1985	13,353	-4.3	1,830	-12.3
1984	13,950	9.7	2,087	-8.7
1983	12,720	10.0	2,287	18.4
1982	11,563	-8.6	1,931	2.4
1981	12,654	6.8	1,886	-20.8
1980	11,852	—	2,380	—

*Export figures prior to 1989 include folding carton stock. Exports including carton stock in 1989 (2,372) rose by 3.3%.
n.m. = Not meaningful.
Source: American Paper Institute.

ple's Rep. China were down 14.5% to 191,690 tons in 1991 after rising sharply the previous year. However, shipments to Hong Kong (a major transshipment point to the rapidly growing export zones of China) were up substantially. Total exports to the Far East and Oceania (excluding China) were up 3.6% to a new high of 506,380 metric tons. U.S. exports to Japan, however, were down 8.9% to 126,000 tons, the lowest level since 1982.

Prices in such markets as Singapore, Malaysia, Hong Kong, and Taiwan tend to be volatile because some U.S. mills use the region as a dumping ground during periods of domestic oversupply. Prices dropped from a peak of $550 to $570 c.i.f. in second-quarter 1988 for lightweight (125-g) linerboard to about $470 to $510 through most of 1991. Regular West Coast suppliers tend to be at the upper end of the range, with irregular spot sellers at the lower end. U.S. producers announced a $30/ton price increase in fourth-quarter 1991, but it was uncertain if the increase would take hold.

Japan. Despite Japan's healthy economic growth and strong currency, linerboard imports have declined for four consecutive years. Corrugated box shipments in 1991, for example, rose by 4.3%. However, Japan's total linerboard imports declined by 15.5% to 145,000 tons, according to government data. The Japanese market has suffered from domestic overcapacity for many years, and the price of K2 linerboard (the most common grade, containing about 40% wastepaper) has been flat. This has kept pressure on import prices, making Japan a less-attractive market for U.S. suppliers. The price of heavyweight kraft linerboard in Japan has fallen below that of other major export markets.

Prices in the Japanese market tend to be more stable because of special quality requirements and long-term business relationships that make it difficult for spot sellers to enter the market. Weyerhaeuser, the largest exporter to Japan, set up a warehouse system and sells liner in yen delivered to Japanese customers. Other major suppliers to Japan are International Paper, Eurocan Pulp & Paper Co. and Stone Container. Some analysts expect U.S. linerboard exports to Japan to increase because of uncompetitive production costs in that country resulting from high fiber and energy costs. In addition, Japanese linerboard mills in 1991 were running at full capacity, up from as low as 70% in mid-1980. But incremental capacity expansion in Japan could limit the growth of imports.

People's Rep. China. The wild card in the U.S. linerboard export picture is People's Rep. China, which in some years is the single largest importer. U.S. shipments in 1987 increased 54% to 258,000 tons—second only to the record 289,000 tons shipped to that country in 1980, when it began making major purchases from U.S. suppliers. Since then, People's Rep. China has bought in surges, with shipments during the weakest years dropping to around 100,000 tons. These surges reflect the country's inventory cycles and its attempts to buy at the lowest prices in the U.S. market.

Orders from People's Rep. China fell off in the second half of 1987 and remained weak through the first half of 1989. Despite the civil unrest that paralyzed the country in mid-1989, exports in 1989 rose to 224,000 tons but then dropped to 191,640 tons in 1990. Prices to China are normally low. U.S. producers in fall 1991 announced a $30 to $40/ton price increase from the $350/metric ton f.a.s. level, but Chinese buyers were resisting the increase.

The long-term outlook for U.S. linerboard exports to People's Rep. China is positive because of that country's strong economic growth, its drive to increase exports, and its limited wood resources. Most of the kraft linerboard imported into People's Rep. China is used for packaging export products. The country imports linerboard through China Pack and Ministry of Light Industries. International Paper is believed to be the largest U.S. exporter to China.

Latin America. The U.S. is the main linerboard exporter to Latin America and the Caribbean, where the traditional large buyers have been banana companies. Kraft linerboard imports to Mexico and Central America rose 20.4% to 419,850 tons in 1991, helped by free market reforms and efforts to attract more foreign investment, according to the API report. The most notable example of such reforms was in Nicaragua under its new democratic government. U.S. exports to Mexico increased by 43% to 115,000 tons in 1991, stimulated by increasing Mexican exports of agricultural and electronic products to the U.S. Costa Rica remained the largest importing country in the region, purchasing 117,670 tons of U.S. linerboard in 1991.

U.S. linerboard exports to South America jumped 40% to 243,690 metric tons, with Colombia and Ecuador accounting for the largest share. Brazil is a major linerboard exporter in the region but shipped only 7,470 tons to its regional neighbors in 1991. However, Brazil increased its total exports by 13% to 308,160 metric tons in 1991 due to sharply lower export demand. Klabin, the largest producer in Brazil, plans to install a new export-oriented machine with capacity of around 200,000 tpy for completion in 1992 (this will replace some existing capacity for a net gain of about 50,000 tpy).

Brazil and possibly Chile, with their low-cost wood resources, may emerge as major competitors with U.S. producers in world linerboard export markets. Several U.S. companies, including Jefferson Smurfit, Stone Container, and Union Camp, operate containerboard mills or box plants in Mexico and South America.

OUTLOOK

Most analysts believe the outlook for linerboard is brighter than for most segments of the paper industry because of less overcapacity and the low-cost position of U.S. producers in the world market. Box shipments have begun to pick up from the 1990-91 recession and should increase 3% to 4% in 1992. Export shipments have been surging and are expected to show some further growth in 1992 unless the U.S. dollar begins to climb sharply in value. With almost no major new capacity additions, operating rates for kraft linerboard mills in 1992 should hit 97% to 98% of capacity (or 95% to 96% with the inclusion of recycled linerboard). This projection assumes some slight downward revision in unbleached kraft linerboard capacity, reflecting at least one recent shutdown.

Paperboard:

CORRUGATING MEDIUM

Corrugating medium is used to form the central or middle fluting material in corrugated containerboard. It is first fluted or corrugated in a corrugator and then faced on both sides with linerboard to form the rigid combined board.

Corrugating medium is made from both semichemical pulp and recycled fiber. In 1990, about 74% of U.S. corrugating medium was made from semichemical pulp furnish (which typically contains some recycled fiber). The remaining 26%, called "bogus" medium, was produced from 100% recycled fiber. Basis weights of corrugating medium are 22, 26, 31, 33, 36, and 40 lb/1,000 ft^2.

Semichemical corrugating medium is made primarily from hardwoods (although some mills find it difficult to pulp certain species, such as white oak). Western mills sometimes use softwood species. Softwood sawdust is also used. Semichemical medium is normally manufactured on conventional fourdrinier paper machines, but a small percentage is produced on cylinderboard machines. A couple of mills in Wisconsin and Virginia produce medium using twin-wire formers.

Semichemical medium contains some long fiber to improve paper machine runability and to lessen the tendency of medium to crack and break upon corrugating. The principal sources of long fiber are waste corrugated containers and new double-lined kraft cuttings. The amount of secondary fiber used varies from 0% to 50%, but average wastepaper content is close to 33% (even though the American Paper Institute still defines semichemical medium as containing no less than 75% virgin woodpulp). In some cases, screenings from kraft mills or kraft softwood pulp are used as the source of long fiber.

Semichemical pulping combines a mild chemical pulping of chips prior to mechanical defibrating and produces a fairly high yield—60% to 80%—as well as an intermediate-strength level. Neutral sulfite semichemical (NSSC), developed in the 1920s, was the original semichemical pulping process. Sodium sulfite and soda ash were used, and pulping was initially performed using rotary batch digesters. Most semichemical mills now use continuous digesters and have shifted from NSSC to the newer carbonate-base and green-liquor semichemical pulping processes.

More than 60% of U.S. semichemical mills have shifted from NSSC to the Owens-Illinois Inc. sulfur-free and green-liquor processes. These processes, developed since the 1960s, are simpler and less capital-intensive, and they have fewer pollution problems. The O-I process uses soda ash (sodium carbonate) and a small amount of caustic soda, and it is adaptable to existing stand-alone semichemical mills

U.S. STATISTICS FOR CORRUGATING MEDIUM

(000 short tons)

	1992e	1991e	1990
Production			
Semichemical	5,820	5,640	5,710
Recycled	2,140	1,990	1,985
Total	7,960	7,630	7,695
Capacity			
Semichemical	5,980	5,810	5,845
Recycled	2,370	2,330	2,230
Total	8,350	8,140	8,075
Utilization rates, %			
Semichemical	98.0	97.2	97.7
Recycled	90.3	85.2	89.0
Imports	135	130	140
Exports	150	165	145
Apparent U.S. consumption			
000 tons	7,945	7,593	7,690
lb/capita	61.92	55.68	60.94
000 tons/billion $ real GNP	1.85	1.82	1.84

e = Estimate.
Sources: American Paper Institute, *Pulp & Paper* estimates.

with only minor equipment modifications.

Green-liquor semichemical pulping uses kraft green liquor; therefore, the process can be used only in combination with a kraft mill. Such cross-recovery reduces chemical processing and recovery and minimizes capital costs. Both the O-I and green-liquor processes produce a semichemical pulp that is comparable in quality with NSSC but has a darker color. Wetting agents, however, must be added to the refined stock to control glue absorption in the finished board.

Mills that produce bogus medium use mostly old corrugated containers (OCC) as a fiber source. Because waste corrugated containers contain foreign materials (tape, hotmelts, latexes, asphalt, waxes, etc.), mills use cleaning equipment to remove contaminants from the stock. Additives such as modified starches and gums are used to improve the strength, or concora, of bogus medium. At 5 to 10 lb/ton, these additives can improve concora by 10% to 20%.

The principal test used to judge the strength of corrugating medium is the concora test. Concora is controlled by refining and through choice of fiber types. Typical concora values for standard basis weights are 60 to 70 lb for 26-lb medium and 70 to 90 lb for 33-lb medium.

Most semichemical medium is produced at 26 lb/1,000 ft^2, but the trend is toward heavier weights. Weights of 36 to 40 lb and higher now account for about 8% of total semichemical production—up from virtually nothing at the beginning of the 1980s. This reflects an industry move toward more performance-oriented corrugated packaging that emphasizes top-to-bottom compression strength in finished boxes (see Linerboard and Converted Products chapters). Compression strength requirements can be met using lower-basis-weight linerboard as well as heavier-weight corrugating medium, resulting in reduced fiber costs.

Wet-strength grades have grown in popularity (mainly in 33, 36, and 40-lb weights) and now account for about 5% of semichemical medium production. Corrugating medium for conventional uses is not sized. Hard sizing would interfere with starch gluing and result in poor adhesion between liner and medium.

The U.S. has 38 semichemical medium mills, with approximately one-third of total industry capacity located in the Upper Midwest hardwood region. Most Canadian ca-

U.S. PRODUCTION AND CAPACITY OF CORRUGATING MEDIUM

(000 short tons)

	SEMICHEMICAL					RECYCLED	
	Production		Capacity			Production	
Year	Tonnage	Change (%)	Tonnage	Change (%)	Operating rate	Tonnage	Change (%)
1993e	—	—	6,072	1.5%	—	—	—
1992e	—	—	5,982	2.9	—	—	—
1991e	—	—	5,812	-0.6	—	—	—
1990e	5,710	0.3%	5,845	1.1	97.7%	1,982	11.0%
1989	5,692	0.4	5,781	-0.1	98.5	1,785	-2.1
1988	5,668	1.3	5,788	1.9	97.9	1,824	13.5
1987	5,598	4.2	5,682	2.2	98.5	1,607	2.5
1986	5,373	5.6	5,557	2.7	96.7	1,568	5.5
1985	5,088	-1.6	5,411	3.0	94.0	1,486	6.4
1984	5,169	9.3	5,252	1.9	98.4	1,397	-9.6
1983	4,731	7.8	5,156	-1.0	91.8	1,545	8.3
1982	4,389	-7.0	5,207	4.4	84.3	1,427	8.5
1981	4,717	-0.1	4,988	0.8	94.6	1,315	2.7
1980	4,723	0.7	4,946	1.7	95.5	1,281	-1.5
1979	4,689	5.6	4,864	2.6	96.4	1,301	-7.6
1978	4,439	4.1	4,739	1.7	93.7	1,408	9.5
1977	4,264	3.9	4,661	-2.0	91.5	1,286	23.7
1976	4,105	10.9	4,758	4.9	86.3	1,040	32.0
1975	3,702	-11.3	4,536	2.4	81.6	788	-29.3
1974	4,175	-2.0	4,430	1.0	94.2	1,115	-7.4
1973	4,260	6.2	4,386	5.6	97.1	1,204	27.8
1972	4,010	8.4	4,155	5.5	96.5	942	7.2
1971	3,700	5.7	3,938	2.4	94.0	879	-4.0
1970	3,500	—	3,847	—	91.0	916	—

e = Estimate.

1. Excludes small amount of export tonnage.

Sources: American Paper Institute, *Pulp & Paper* estimates.

pacity is located in the eastern and Maritime provinces, and some of these mills ship to the northeastern U.S. Recycled medium mills are usually located in major urban areas, near wastepaper supplies and major box markets, giving them an advantage in transportation costs.

INDUSTRY STRUCTURE

The corrugating medium market tends to be overshadowed by the larger linerboard market and is more competitive and regionalized. A larger number of players are in the medium market, even though U.S. production is less than half that of linerboard. More than 35 companies in the U.S. produce semichemical and recycled medium on about 44 machines of varying capacity, trims, and product quality. By contrast, 21 companies are producing linerboard on about 52 machines. Recycled medium increased its total share of the U.S. medium market from about 23% in 1987 to more than 28% by 1991 based on capacity. The growing importance of recycled medium and the increasing use of recycled fiber in semichemical medium will increasingly link medium to the vicissitudes of the wastepaper market. Another difference with linerboard is that only about 2% of semichemical medium is exported (vs 15% for linerboard), while imports (mainly from Canada and Mexico) play a larger role in the U.S. market.

The cost profiles of corrugating medium producers show greater range, reflecting wider variation in mill size and fiber furnish costs. About one-third of U.S. semichemical medium capacity is represented by machines that produce 125,000 tpy or less. Two U.S. semichemical machines have capacity to produce over 300,000 tpy each. Nekoosa Packaging Inc.'s Tomahawk, Wis., mill and Mead Corp.'s Stevenson, Ala., mill are two of the most efficient medium mills. Recycled mills tend to be older and less efficient, but they may have an advantage when wastepaper costs are low. In 1975, Inland Container Corp. built the first large, new recycled medium mill in the U.S. since the 1930s in Newport, Ind., and the mill currently has capacity to produce about 250,000 tpy.

Stone Container Corp. is the largest producer of corrugating medium, with total semichemical and recycled ca-

continued

(000 short tons)

RECYCLED			TOTAL CORRUGATING MEDIUM				
Capacity			Production		Capacity		
Tonnage	Change (%)	Operating rate	Tonnage	Change (%)	Tonnage	Change (%)	Operating rate
2,402	1.4%	—	—	—	8,474	1.5%	—
2,368	1.7	—	—	—	8,350	2.6	—
2,328	4.4	—	—	—	8,140	0.8	—
2,229	9.2	88.9%	7,692	2.9%	8,074	3.2	95.3%
2,042	4.9	87.4	7,477	-0.2	7,823	1.1	95.6
1,947	15.5	93.7	7,492	4.0	7,735	5.0	96.9
1,685	6.6	95.4	7,205	3.8	7,367	3.2	97.8
1,580	3.7	99.2	6,941	5.6	7,137	2.9	97.3
1,523	-0.1	97.6	6,574	0.1	6,934	2.3	94.8
1,524	-2.0	91.7	6,566	4.6	6,776	1.0	96.9
1,555	5.2	99.4	6,276	7.9	6,711	0.4	93.5
1,478	9.6	96.5	5,816	-3.6	6,685	5.5	87.0
1,349	1.4	97.5	6,032	0.5	6,337	1.0	95.2
1,330	-4.5	96.3	6,004	0.2	6,276	0.3	95.7
1,392	3.6	93.5	5,990	2.4	6,256	2.9	95.7
1,343	0.4	104.8	5,847	5.4	6,082	1.4	96.1
1,337	-9.4	96.2	5,550	7.9	5,998	-3.8	92.5
1,476	1.9	70.5	5,145	14.6	6,234	4.2	82.5
1,449	6.7	54.4	4,490	-15.1	5,985	3.4	75.0
1,358	15.3	82.1	5,290	-3.2	5,788	4.0	91.4
1,178	10.8	102.2	5,464	10.3	5,564	6.6	98.2
1,063	6.3	88.6	4,952	8.1	5,218	5.7	94.9
1,000	1.7	87.9	4,579	3.7	4,938	2.2	92.7
983	—	93.2	4,416	—	4,830	—	91.4

pacity of about 920,000 tpy (about 11.3% of the total market). Georgia-Pacific Corp. is the second largest producer, with 825,000 tpy of semichemical capacity (including 50% of a machine owned jointly with Sonoco Products Corp.). Paçkaging Corp. of America is almost the same size since its acquisition of G-P's Tomahawk mill and a smaller recycled medium mill. One major medium mill, Virginia Fibre Corp. (275,000 tpy), has no box plants and sells exclusively to independent converters. And one major integrated linerboard producer, Union Camp Corp., has no medium mills.

CAPACITY RANKINGS OF U.S. CORRUGATING MEDIUM PRODUCERS

(000 short tons)

		Annual capacity			
	Company	Semichemical medium	Recycled medium	Total	Capacity share (%)
1	Stone Container	680	240	920	11.3%
2	Georgia-Pacific	825[1,3]	—	825	10.1
3	Packaging Corp. of America	750[1]	70	820	10.1
4	Weyerhaeuser	715	—	715	8.8
5	Temple-Inland	240	370	610	7.5
6	Jefferson Smurfit/CCA	120	390	510	6.4
7	Mead	380	—	380	4.7
8	International Paper	380	—	380	4.7
9	Willamette Industries	185	175	360	4.4
10	Virginia Fibre	275	—	275	3.4
11	MacMillan Bloedel	255	—	255	3.1
12	Menasha	230	—	210	2.6
13	Weston Paper	180	—	160	2.0
14	Chesapeake	—	150	150	1.8
15	Waldorf	—	145	145	1.8
16	Manville Forest Products	140	—	140	1.7
17	Cascades	—	125	125	1.5
18	Boise Cascade	110	—	110	1.4
19	Groveton Paper Board	105[2]	—	105	1.3
20	Westvaco	100	—	100	1.2
21	Longview Fibre	90	—	90	1.1
22	Grief Board	—	85	85	1.0
23	Sonoco Products	85	—	85	1.0
24	Corrugated Services	—	80	80	1.0
25	Consolidated Packaging	75	—	75	0.9
26	Fairfield Paper	—	65	65	0.8
27	Cleaners Hanger	—	60	60	0.7
28	Visy Board	—	50	50	0.6
29	Connelly Containers	—	45	45	0.6
30	Newark Boxboard	—	35	35	0.4
31	Interstate	—	30	30	0.4
32	Menominee Paper (Bell Fibre)	—	25	25	0.3

U.S. capacity (1991): 8.271 million short tons
Semichemical: 5.920
Recycled: 2.351
Market share of top five companies: 47.8%
Market share of top ten companies: 71.3%

[1] Reflects Georgia-Pacific Corp.'s sale of its Tomahawk, Wis., mill (445,000 tpy semichemical) in early 1991.

[2] Owned 31% by Jefferson Smurfit Corp. and 69% by SPB Canada; machine operated by James River Corp.

[3] Reflects 50% interest in 170,000-tpy semichemical medium machine jointly owned by Georgia-Pacific and Sonoco Products Co. at the latter's Hartsville, S.C., mill; G-P markets output.

A number of indefinitely idled medium machines are not shown: Clinch River Corp., Harriman, Tenn. (70,000 tpy semichemical) idled 1/90; Gaylord Container Corp., Antioch, Calif. (110,000 tpy recycled) 3/91; Cornwall Paper Mills Co., Cornwall, N.Y. (60,000 tpy recycled) 8/91

CURRENT MARKET CONDITIONS

The U.S. corrugating medium market appeared to have begun a turnaround in fall 1991 thanks to a pickup in corrugated box demand and almost no capacity growth. With medium in increasingly tight supply in many regions, producers were able to push through about a $30/ton price increase in September.

Prices for corrugating medium began their downward slide in second-half 1988 due to slower growth in U.S. corrugated box shipments, substantial new capacity additions in recycled medium capacity (combined with a sharp drop in wastepaper costs), and increased competition from imports. Growth in box shipments declined from 4.9% in 1987 to 3.6% in 1988, 1.6% in 1989, and 1.5% in 1990. Reflecting the weakness in box cut-up, corrugating medium production (semichemical and recycled) declined 0.2% in 1989 and rose 2.9% in 1990 but was expected to be down nearly 1% in 1991.

At the same time the market began to weaken, corrugating medium capacity jumped by 5% in 1988, paced by a 15.5% jump in recycled medium capacity. The increased capacity plus slower demand caused operating rates for semichemical medium mills to decline only slightly, from close to 99% in 1989 to 97% by 1991. Operating rates for recycled medium mills, however, dropped to the 85% to 89% range. The lower operating rates for recycled mills combined with a roughly 40% drop in OCC costs from 1988-89 were probably a major factor behind the increasing price competition.

Prices on medium were last increased in March 1988, when the list price for 26-lb semichemical medium was raised by $30/ton to $400. Transaction prices, however, began to ease in second-half 1988, and by fourth-quarter 1989, they had reached about $350 to $360/ton in the eastern U.S. Prices continued to decline through the second quarter of 1990, dropping to about $320 in the eastern U.S. before stabilizing. In fall 1990, some producers announced an Oct. 1 list price increase to $350 for semichemical medium and to $340 for recycled medium.

But this price increase was unsuccessful, and prices eroded further through first-half 1991, reaching about $280 to $290 and even lower in the eastern U.S. Prices on the West Coast bottomed at about $310 to $320 due to higher fiber costs. The medium market began to firm in the summer with a pickup in U.S. corrugated box shipments, and producers successfully pushed through a $30/ton price increase in September on both linerboard and medium. The increase brought the list price to $330/ton for semichemical and to $320 for recycled medium in the eastern U.S. Transaction prices for semichemical, however, ranged from about $320 to below $300 in the northeastern U.S. But such low transaction prices probably will gradually come up due to tightening supply.

Medium producers in fall 1991 were also hoping to narrow the price differential between linerboard and medium from about $50/ton or more to $40/ton or less--which they said better reflected the cost differential between producing the two grades. For many years, semichemical medium sold at a $10 differential to kraft linerboard. Producers, however, were unable to restore this differential after the 1985 industry downturn, in which semichemical medium prices dropped to about $230 to $240/ton (opening about a $20 to $30 gap with linerboard). One reason for the large differential is the growing presence of recycled medium and the low cost of secondary fiber. Another reason is that, unlike linerboard, medium is not getting any support from stronger export demand due to weakness in the dollar. Recycled medium typically sells for about $10/ton less than semichemical medium.

One troublesome factor for U.S. medium producers was an increase in low-priced corrugating medium imports from Canada and Mexico over the last few years. Such imports from Canada rose to about 157,000 metric tons in 1990, up from 130,000 tons in 1989, according to Canadian Pulp & Paper Assn. statistics. The Canadian imports tended to depress price levels in the northeastern U.S., while imports of Mexican medium had the same effect in such places as Texas and southern California. U.S. exports of corrugating medium (mainly to Central America and the Caribbean) have been relatively flat at around 140,000, and prices have been low.

CAPACITY TRENDS

Higher-than-normal capacity growth for corrugating medium, particularly recycled, has been a major factor behind the current market weakness. Total U.S. corrugating medium capacity rose at a 3.1%/year average rate over the 1987-90 period, with recycled medium capacity shooting up close to 9.1%/year. Recycled medium capacity jumped from 1.69 million tons in 1987 to 2.2 million tons in 1990. Growth in semichemical medium capacity was more moderate, rising 1.7%/year over the same period to 5.8 million tons in 1990.

Since then, however, the collapse in medium prices and poor industry profitability have caused capacity growth to slow nearly to a halt.

According to the 1990 API capacity survey, semichemical medium capacity will rise only 1.2%/year over the 1990-93 period, while recycled medium will decelerate to 2.5%/year and total medium capacity will increase only 1.6%/year. The industry capacity base and expected growth rate may be revised downward in the next API survey because of project postponements, the shutdown of some older machines, and the shift of some machines to recycled bag paper production.

The growth in semichemical medium capacity has come from rebuilds of existing machines to improve quality and add incremental capacity. These projects have sometimes included installation of wide-nip presses and additional OCC processing capability. Two projects of this type (each adding about 40,000 tpy) were completed in 1991 by Menasha Corp. at Otsego, Mich., and Weston Paper & Manufacturing Co. at Terre Haute, Ind. The last large, new semichemical medium machine in the U.S. was installed in 1983 at

MAJOR U.S. CORRUGATING MEDIUM EXPANSION PROJECTS

Company	Mill location	Capacity (000 short tpy)	Startup date
Announced			
Clinch River	Harriman, Tenn	(107)S[1]	1990
Visy Board	Hartford City, Ind.	70R	1990
Green Bay Packaging	Green Bay, Wis.	(170)S[2]	1991
Gaylord Container	Antioch, Calif.	(100)R	1991
Cornwall Paper	Cornwall, N.Y.	(50)R	1991
Temple-Inland	Newport, Ind.	42R	1991
Cascades	Niagara, N.Y.	35R	1991
Menasha	Otsego, Wis.	40S	1991
Willamette	Hawesville, Ky.	40S	1991-93
Weston	Terre Haute, Ind.	40S	1992

S = Semichemical.
R = Recycled.
1. Mill closed at end of 1989 due to financial difficulties.
2. Conversion of machine from semichemical medium to recycled linerboard.

U.S. PRICES FOR CORRUGATING MEDIUM

(semichemical, 26-lb, eastern U.S.)

Year	$/short ton	$/1,000 ft²
1991		
4Qe	$310/320*	$4.03/4.16
3Q	280/290*	3.64/3.77
2Q	290*	3.77
1Q	300*	3.90
1990		
4Q	320*	4.16
3Q	320/330*	4.16/4.29
2Q	330/340*	4.29/4.42
1Q	340/350*	4.42/4.55
1989		
4Q	350/360*	4.55/4.68
3Q	360/370*	4.68/4.81
2Q	380/390*	4.94/5.07
1Q	380/390*	4.94/5.07
1988		
4Q	390/400*	5.07/5.20
3Q	390/400*	5.07/5.20
2Q	400*	5.20
1Q	360/370*	4.68/4.81
1987		
4Q	350/360*	4.55/4.68
3Q	330/340*	4.29/4.42
2Q	320/330*	4.16/4.29
1Q	320/330*	4.16/4.29
Year end		
1986	290/300*	3.77/3.90
1985	240	3.12
1984	310	4.03
1983	280	3.64
1982	240*	3.12
1981	260*	3.38
1980	260	3.38
1979	240	3.12
1978	210	2.73
1977	180*	2.34
1976	200*	2.60
1975	190	2.47
1974	190	2.47
1973	140	1.82
1972	123	1.60
1971	120	1.56
1970	120	1.56

Prices shown above generally reflect net transaction levels in the eastern U.S. Medium prices tend to have a broader range than linerboard and vary regionally. Prices are typically lowest in the Northeast and may be somewhat higher in parts of the Midwest and South. Prices on the West Coast may be $10 to $20/ton higher than those in the eastern U.S.

Basis weight differentials: Based on eastern list for 26-lb semichemical medium of $350 ($4.55/1,000 ft^2), prices for other weights are about as follows: 30 lb, $350 ($5.25); 33 lb, $350 ($5.78); 36 lb $350 ($6.30) and 40 lb $360 ($7.20). Prices for recycled medium are generally about $10/ton below those of semichemical medium.

*Indicates some discounting below transaction levels shown.
Source: *Pulp & Paper Week.*

MacMillan Bloedel Inc.'s Pine Hill, Ala., mill. Two idle mills have recently been converted to producing recycled medium by Cascades Inc. at Niagara, N.Y., in 1988 and Visy Recycle Inc. (part of the Pratt Group of Australia) in Hartford City, Ind., in early 1990.

Holding down the rate of capacity growth for medium have been one large machine conversion and several shutdowns. Green Bay Packaging Inc., in early 1991, converted its 170,000-tpy semichemical machine to recycled linerboard production. Mill shutdowns include the Clinch River Corp. semichemical medium mill (100,000 tpy) in Harriman, Tenn., at the end of 1989, a recycled machine at Gaylord Container Corp.'s Antioch, Calif., mill (100,000 tpy) in 1991, and Cornwall Paper Mills Inc. (60,000 tpy) in Cornwall, N.Y., in 1991. Meanwhile, some recycled medium mills, such as Stone Container's 130,000-tpy York, Pa., mill, have been shifted over to recycled bag paper because of growing demand and better prices for that grade.

CANADIAN CONTAINERBOARD MARKET

The Canadian containerboard industry (both linerboard and medium, including recycled) is much smaller than the U.S. industry. Canada has capacity to produce about 2.5 million short tpy, compared with about 30 million tpy for the U.S. This reflects the fact that the Canadian industry serves mainly the domestic market, which has a population

CANADIAN CONTAINERBOARD PRODUCTION

(000 metric tons)

Year	Total containerboard	Linerboard*	Corrugating medium*
1990	2,045	1,304	741
1989	1,945	1,218	726
1988	1,981	1,267	715
1987	1,954	1,255	699
1986	1,847	1,199	648
1985	1,677	1,126	551
1984	1,695	1,087	608
1983	1,575	1,021	554
1982	1,364	891	473
1981	1,646	1,088	558
1980	1,671	1,175	496
1979	1,544	1,078	466
1978	1,520	1,023	497
1977	1,434	1,037	397
1976	1,315	949	366
1975	1,031	726	305
1974	1,494	1,031	463
1973	1,413	975	438
1972	1,240	855	385
1971	1,033	686	347
1970	1,041	710	331

*Includes some recycled paperboard.
Source: Canadian Pulp & Paper Assn.

of only 25 million and an economy about one-twelfth that of the U.S. About 90% of the industry's production is integrated forward to corrugated container production.

Canada's containerboard industry developed behind high tariff walls, and many of its facilities are not competitive in size or scale with mills in the U.S. The higher cost structure for the Canadian industry also reflects the fact that linerboard is a fiber-intensive grade, while the growing cycle for wood in northeastern Canada is slow and harvesting and transportation costs are high. A 15% tariff protected the containerboard industry until 1980. Under General Agreement on Tariffs & Trade negotiations completed in the late 1970s, tariffs dropped to 6.5% in 1987 for kraft linerboard and 4% for corrugating medium. Staged reductions during the next five years will eliminate the tariffs by 1993.

It is still uncertain how the new Free Trade Agreement between the U.S. and Canada will affect imports and exports of containerboard and corrugated containers. The move toward a more open, internationally competitive marketplace will be painful for many Canadian producers. Since 1977, three containerboard mills have closed—two export-oriented kraft linerboard mills (Labrador Linerboard and MacMillan Bloedel Ltd.) and a recycled linerboard mill. In total, these closures removed about 500,000 tpy of linerboard capacity from the market, although production still showed some growth. During 1977-90, Canadian linerboard production increased from 1.037 million metric tons to more than 1.4 million tons. At the same time, corrugating medium grew at a faster rate, rising from 397,000 tons to 741,000 tons, according to CPPA.

The Canadian linerboard industry is far more dependent on secondary fiber. Recycled linerboard accounts for about 25% of total linerboard capacity, compared with about 3% in the U.S. However, recycled medium in Canada accounts for about 19% of total production—slightly lower than in the U.S.

The corrugated container industry in Canada is almost totally integrated, with independents having well under 10% of the corrugated market (vs roughly 20% in the U.S.). Two integrated corrugated companies, Domtar Inc. and MacMillan-Bathurst Inc., account for more than half of the Canadian industry's box production. MacMillan-Bathurst is a 50:50 joint venture of MacMillan-Bloedel and Stone-Consolidated Inc. Canadian Pacific Forest Products Ltd. ranks third, with about an 11% share of the market.

More than 25% of both linerboard and medium production is shipped outside of Canada (Eurocan Pulp & Paper Co. is the largest liner exporter, and Stone-Consolidated and Papier Cascades Inc. are the biggest medium exporters). While imports of linerboard are relatively small, imports of finished boxes have grown significantly. During 1982, a large part of the eastern Canadian corrugated industry was shut down by labor problems, and several U.S. box plants located near the border started shipping into Canada.

Canadian containerboard prices tend to follow those in the larger U.S. market, although they are at somewhat higher levels even after duty. Canadian producers last raised list prices on Apr. 1, 1988. Kraft linerboard (42 lb) went up C$35/metric ton to C$675 list, and semichemical medium (26 lb) rose C$30/ton to C$630. Reflecting the increase in raw material costs, Canadian corrugated box manufacturers raised prices by 5% to 6%. Containerboard and box prices, however, have been eroding for the past couple years.

Some industry experts doubt if another kraft linerboard mill will ever be built in Canada, although incremental expansion is taking place. The 1991 CPPA capacity survey showed kraft linerboard capacity increasing 10.3% to 1.08 million metric tons between 1990 and 1993. This mainly reflects Eurocan's rebuild of a machine at its Kitimat, B.C., mill, which will add 105,000 tpy of capacity (pulping was expanded through installation of a chemimechanical pulping system—a new type of pulp for manufacturing kraft linerboard). Recycled linerboard capacity will rise about 3% to 407,000 tons by 1993.

Semichemical medium capacity is expected to increase 9.4% to 730,000 tons by 1993. Stone-Consolidated installed a new 150,000-tpy machine at its Matane, N.B., mill in late 1988, replacing two older machines. Recycled medium capacity is expected to rise by about 7.8% to 110,000 tpy in 1993.

ESTIMATED CONTAINERBOARD CAPACITY OF MAJOR CANADIAN PRODUCERS

(000 metric tpy)

	Linerboard	Corrugating medium	Total containerboard
Domtar	270**	145**	415
Stone-Consolidated	200	160[1]	360
CIP	225	85	310
Eurocan Pulp & Paper	268[2]	—	268
Paperboard Industries[3]	85*	50*	135
Cascades	—	115**	115
Atlantic Packaging	60*	40*	100
Irving (Lake Utopia)	—	90	90
Kruger	90*	—	90
MacMillan Bloedel	—	70	70
Crown Forest	35	25	60

*Recycled containerboard.

**Includes some recycled containerboard capacity.

1. New 150,000-tpy machine installed at Bathurst, N.B., mill replaced two older machines for 45,000-tpy net increase in 1989.
2. Rebuild increased Kitimat, B.C., mill's capacity 105,000 tpy in 1989.
3. Company selling its assets.

Paperboard:

COATED AND UNCOATED KRAFT

Unbleached kraft paperboard other than linerboard is produced for three major packaging markets: beverage carriers, folding cartons, and multi-pack packaging for products traditionally packaged in corrugated containers. The remainder is used for tube, can, and drum stock and other industrial converting applications. These miscellaneous uses are discussed at greater length in the chapter on converted products.

Unbleached kraft board is produced from 100% unbleached kraft sulfate pulp. A small amount of wastepaper may also be used in the kraft pulp furnish.

Coated and uncoated kraft boxboard is unique because it offers a package with much higher strength than equivalent-weight bleached and recycled boxboard grades. In many cases, the strength of kraft boxboard allows dual-packaging capabilities as both a shipping container and a folding carton that can be displayed. In addition, coated kraft boxboard is well suited for high-quality printing and foil and film laminating. Because of these properties, kraft board has had a major impact in the folding carton market.

Kraft boxboard and converting grades comprise only 6% of the total unbleached kraft paperboard market, but they account for about 18% of the domestic boxboard market (about 1.2 million short tons). The principal market for kraft boxboard is beverage-carrier stock—mainly for six-packs of bottled beer, soft drinks, wine coolers, and mineral water and also for larger, 24-unit multi-packs. The carrier market consumes nearly 70% of total kraft boxboard tonnage. Carrier stock used in refrigerated applications is made with wet-strength additives in either the kraft furnish, the coating, or both. Typically, carrier stock has a basis weight of approximately 84 lb/1,000 ft^2 and a caliper thickness of 20 pt.

More recently, clay-coated kraft board has made a significant breakthrough in traditional folding carton markets. Kraft boxboard competes with recycled clay-coated newsback (CCNB) and solid bleached sulfate (SBS) board. Kraft boxboard provides better stiffness, tear resistance, and moisture resistance than SBS and has better printing and strength qualities than CCNB. Kraft boxboard is often used in larger-size packages for detergents and other nonfood items and as institutional packaging for wholesale distribution. Kraft boxboard is also used as preprinted linerboard for small corrugated containers that are used to package

UNBLEACHED KRAFT PAPERBOARD CAPACITY FOR FOLDING CARTONS AND OTHER USES

(000 short tons)

Year	Folding cartons[1]	Other uses[2]
1993e	1,572	487
1992e	1,521	486
1991e	1,424	485
1990e	1,242	485
1989	1,183	503
1988	1,055	509
1987	1,000	473
1986	946	501
1985	905	500
1984	792	477
1983	800	493
1982	860	509
1981	804	540
1980	852	529
1979	827	520
1978	650	540
1977	645	561
1976	595	525

e = Estimate.

1. Includes carrier board.

2. Includes tube, can, and drum stock.

Source: American Paper Institute.

consumer products. Such boxes not only are used to ship the product but also serve as point-of-purchase displays.

INDUSTRY STRUCTURE

Mead Corp. and Riverwood International Corp. (formerly Manville Forest Products Corp.) together produce nearly all of the U.S. supply of coated and uncoated kraft board. Westvaco Corp. also produces this grade. Both Mead and Riverwood International are highly integrated packaging companies with worldwide affiliates that supply packaging materials and systems to the food and beverage industry.

Mead's current capacity for grades it refers to as coated natural kraft (CNK) is approximately 800,000 tpy at the company's Mahrt, Ala., mill. In fourth-quarter 1990, Mead started production on a new, 370,000-tpy coated kraft paperboard machine at Mahrt. The $580-million expansion represented the largest capital expenditure in Mead's history. Mead's coated kraft products include Carton Kote, Carrier Kote, and Carrier Kote II.

Mead acquired 100% ownership of the former Georgia Kraft Co. mill in early 1988, when it dissolved its joint venture with Temple-Inland Inc. Soon after this transaction, Mead broke ground for the mill expansion to install the new coated board machine as well as new pulping and other process equipment.

Riverwood International has production capacity of approximately 600,000 tpy of coated kraft board on three machines at West Monroe, La. Two of the machines were modernized and capacity was increased during the last few years. The rebuilds were designed to improve product quality and machine productivity of coated kraft board. Riverwood International markets its products as Pearl-Kote folding carton board and Aqua-Kote beverage carrier board.

Westvaco is the third player in this market, although its Kraftpak unbleached folding carton board is an uncoated grade. Westvaco has an estimated 70,000 tpy of low-density Kraftpak board capacity at its North Charleston, S.C., kraft mill. Westvaco is a major supplier of uncoated laminating stock to packaging customers. Its uncoated board is also approved by the Food & Drug Administration for food packaging, so its food-grade boards are used for packaging a variety of dry and frozen foods and for bulk packaging in fast-food and institutional markets.

In early 1991, Manville, Mead, and Westvaco together had an estimated total unbleached kraft boxboard capacity of 1.4 million tons. Industry capacity is forecast to increase to about 1.6 million tons by 1993.

In Europe, U.S. coated kraft boxboard competes with similar grades produced in Sweden and Finland. Major European producers are the Billerud and Papyrus Kopparfors divisions of Sweden's Stora Group, the Frovifors Bruk unit of ASSI (AB Statens Skogsindustrier), and Korsnäs AB.

MARKET STRUCTURE

Demand for packaging by the food and beverage industry is the major market for unbleached kraft boards. The food and beverage industry accounted for 45% to 50% of the value, and over 50% of the volume, of folding cartons (including beverage carriers) shipments in 1990.

About 53% of the folding carton industry's 1990 consumption of boxboard was supplied by bleached and unbleached kraft grades. SBS paperboard is the most widely used kraft grade, with about 35% of the market. Unbleached kraft accounts for about 19% of the market. SBS growth was supply-constrained in 1989-90, so the unbleached kraft grades have accounted for most of the growth in the kraft grades. Demand for unbleached kraft grew at the rate of 8.8%/year during the 1960s and 4.6%/year during the 1970s—a higher growth rate than the overall boxboard market, outperforming both SBS and clay-coated recycled grades.

The use of clay-coated unbleached kraft board in folding cartons and carriers grew primarily because it offers considerable savings over SBS and is stronger than recycled board. Other industry statistics indicate that SBS usage in boxboard production increased an average of 4.1%/year during 1983-88. Unbleached kraft boxboard usage increased about 7.5%/year during the same period. Recycled boxboard usage increased an average of 3.0%/year.

In recent years, the folding carton market has been most promising for coated unbleached kraft board producers; future growth is limited only by available capacity. Demand for beverage carriers wavered in the early 1980s as beer consumption eased and as more beverages were bottled in

U.S. PRICES FOR COATED KRAFT BOARD

($/short ton)

Year	20-pt, folding carton, C1S 80 bright (rolls)	20-pt beverage carrier, C1S 80 bright (rolls)
1991		
3Q	$640-650	$650
2Q	615-620	650
1Q	615-620	650
1990		
4Q	615-620	650
3Q	615-620	625
2Q	615-620	625
1Q	615-620	625
1989		
4Q	615-620	625
3Q	615-620	625
2Q	575-580	625
1Q	575-580	625
1988		
4Q	535-540	580
3Q	535-540	580
2Q	505-510	560
1Q	505-510	545
1987	505-510	540-545
1986	460-485	500-525

Source: *Pulp & Paper Week.*

2-liter plastic containers. But this market is rebounding, boosted by a heightened interest in better packaging graphics and by growth in new nonalcoholic products.

Bruce Kirk of Goldman Sachs & Co. estimated that clay-coated kraft board for folding cartons and similar retail merchandise packaging has grown consistently in recent years, with minimal cyclicity. Industry production increased 100% between 1975 and 1988, when it reached about 925,000 tons.

Clay-coated unbleached kraft board, in terms of price and quality, is positioned between clay-coated recycled board and SBS used in milk cartons, cup/plate/food service items, and folding cartons. Generally, coated unbleached kraft board is priced about $100/ton higher than the recycled equivalent and $200/ton lower than the SBS equivalent. In 1989, the prevailing price of 20-pt clay-coated kraft folding carton board was about $580/ton, rising to about $620/ton at the end of the year. The price of beverage carrier board grades was about $625/ton, rising to $650/ton in third-quarter 1990. In mid-1991, producers increased prices for folding carton grades again. Current prices are now about $640 to $650/ton these grades.

Compared with SBS, coated kraft has higher values for tear, mullen or puncture, machine-direction stiffness, and machine-direction block compression. This means a lower-caliper coated kraft board can substitute for SBS, resulting in a 3% to 4% material savings, which is in addition to the 12% to 15% cost savings. According to Riverwood International, it all adds up to a 15% to 19% savings over SBS.

Unbleached kraft board is cheaper to produce because the manufacturing process requires fewer chemicals and less energy and labor. In addition, unbleached kraft has greater strength because it is not bleached, a process that weakens fibers.

Riverwood International. Riverwood makes its solid unbleached sulfate (SUS) grades at its West Monroe mill on Nos. 2, 6, and 7 paper machines. In recent years, major upgrades have improved quality and increased capacity at the mill, and the company is considering the rebuild of an idle No. 4 machine or the installation of a new machine with capacity in the range of 800 to 1,000 tpd. In 1991, Riverwood International committed $40 million to a capital improvement program for the West Monroe mill.

In mid-1985, Riverwood completed a rebuild of No. 7 paper machine, which makes Pearl-Kote grades—the third generation of SUS boards developed by Riverwood. This project reduced board plies to three from four and raised machine capacity to 575 tpd from 540 tpd. Machine capacity is expected to increase gradually to about 800 tpd after an additional machine upgrade is completed in 1991.

Arcu-Formas on No. 7 machine were removed and replaced with a third fourdrinier. No. 7 has a maximum speed of 1,500 fpm with a normal trim of 232 in. It has the largest yankee dryer in the world and coats the board in three stages, which gives it a distinctive bright blue finish.

No. 7's output is converted to food cartons (for frozen pizzas, ice cream, candy, etc.) and boxes for various consumer products and hardware items (e.g., diapers and automobile shock absorbers). It is coated one side (the printing side) and brown (unbleached) on the inside. Calipers range from 14 to 32 pt, and basis weights vary between 56 and 116 lb/1,000 ft^2. Some of the board is polyethylene-extruded on one or both sides by converters for wet or frozen end-use applications.

No. 2 machine produces 235 tpd of lightweight (16 to 20-pt caliper), clay-coated board for both the beverage carrier and folding carton markets, as well as a clay-coated preprinted linerboard. No. 2 machine, which dates from the 1930s, is expected to be retired in the mid-1990s.

No. 6 machine produces mainly Aqua-Kote wet-strength beverage carrier board. It was rebuilt in 1987 and is slowly reaching its annual rated capacity of 900 tpd. The other two machines, Nos. 1 and 5, make semichemical corrugating medium and lightweight kraft paper, respectively, for grocery bags and sacks.

Mead. Mead too is moving ahead with improvements and expansions. Before the startup of its new machine, Mead made all of its CNK grades on a 262-in.-wide fourdrinier at the Mahrt mill. The new Valmet coated board machine has a design capacity of 1,000 tpd with a 300-in. wire width and a design speed of 2,560 fpm. Mead's 1990 production capacity was 430,000 tons, or 39% of industry output. It converts 260,000 tpy, or about 60% of output, at its own domestic beverage carrier and folding carton facilities. The balance of output—170,000 tons, or 40%—is sold on the domestic market to other converters or to Mead's offshore affiliate producers. Mead expects to export about 50% of the production from its new machine.

Mead's paperboard packaging business underwent significant consolidation and restructuring in 1987. It shed its linerboard and recycled paperboard operations as well as six of its 14 corrugated box plants, but it retained the Stevenson, Ala., corrugating medium mill. These divestitures were designed to focus corporate assets on value-added specialty products with higher and less-cyclical profit margins, with major emphasis on CNK.

UNBLEACHED KRAFT PAPERBOARD PRODUCTION BY GRADE, 1968-90

(000 short tons)

	Domestic					
Year	Containerboard[1]	Boxboard[2]	Tube/can	Other	Exports	Total
1990	16,414	970	125	157	2,691	20,357
1989	15,833	987	150	157	2,363	19,490
1988	15,601	924	155	165	2,296	19,140
1987	15,380	865	161	190	2,303	18,898
1986	14,174	889	164	217	2,237	17,680
1985	13,353	822	164	198	1,830	16,367
1984	13,950	752	192	205	2,086	17,185
1983	12,720	710	204	207	2,281	16,122
1982	11,563	691	193	157	1,931	14,535
1981	12,654	672	219	171	1,887	15,603
1980	11,852	680	226	157	2,380	15,295
1979	12,306	698	267	234	1,645	15,150
1978	11,780	618	251	258	1,466	14,373
1977	11,283	588	228	262	1,290	13,651
1976	11,024	577	217	266	1,247	13,331
1975	9,586	463	176	260	1,058	11,543
1974	10,754	470	231	295	1,583	13,333
1973	10,951	455	226	333	1,597	13,562
1972	10,470	389	223	298	1,887	13,269
1971	9,155	339	194	276	1,834	11,800
1970	9,043	343	175	295	1,683	11,541
1969	9,242	287	187	417	1,683	11,816
1968	8,535	261	175	409	1,381	10,761

1. Containerboard figure is mostly linerboard from 1968-78, and is entirely linerboard after 1978.
2. Boxboard figure is folding carton stock and carrier board.
Source: American Paper Institute.

Paperboard:

BLEACHED

Solid bleached sulfate (SBS) paperboard is used primarily for folding carton and milk carton packaging and is produced from a furnish containing at least 80% virgin bleached woodpulp. SBS is also used in the manufacture of disposable cups, plates, and food containers as well as in bleached linerboard. It is sometimes substituted for bleached printing bristols, which are also produced by some SBS mills (see Bristols chapter).

Bleached board is produced in calipers ranging from 10 to 28 pt and in basis weights ranging from 40 to 100 lb/1,000 ft^2. Sheet density is the basis weight divided by the caliper. Density starts at about 10.5 lb/pt (lb/pt of caliper on 1,000 ft^2 basis) or less for low-density board, and it goes up to 16 lb/pt or more for high-density board. Medium-density board is in the range of 12 to 14 lb/pt.

Additives are often mixed with SBS stock furnish to give the sheet certain characteristics, and coatings are added to smooth and seal the sheet. In folding carton board, for example, the sheet is typically coated with a 4 lb/1,000 ft^2 coat weight—typically a kaolin clay coating using S-B latex as a binder. Acrylic binders are also commonly used. In liquid packaging furnish, synthetic waxes and polyethylene (PE) resin coatings are added to improve sheet holdout (liquid resistance) properties.

U.S. STATISTICS FOR BLEACHED BOARD[1]

	1991e	1990	1989
Production, 000 tons	4,557	4,399	4,521
Capacity, 000 tons	4,843	4,619	4,723
Utilization rate, %	94.1	95.2	95.7
Exports, 000 tons	755	734	693
Imports, 000 tons	30	40	20
Apparent U.S. consumption			
000 tons	3,832	3,705	3,848
lb/capita	30.6	29.7	31.0
000 tons/billion $ real GNP (1982)	0.91	0.89	0.93

e = Estimate.

[1] All tons are short tons.

Sources: American Paper Institute, *Pulp & Paper* estimates.

Nearly all bleached board used in folding carton stock is clay coated, and nearly all board used in frozen and liquid food packaging is coated with PE resins. Coating formulas vary according to the desired surface requirements and degree of holdout. On-machine blade coaters are typically used with most machines, but milk carton stock is usually extrusion-coated off the machine at the paper mill.

Gloss calenders are used with machines to improve the finish of high-gloss board. These high-gloss finishes are called cast coatings—a reference to the process in which coated board is pressed against a finished casting surface while the coating is still in a highly plastic state.

A blend of softwoods and hardwoods in about equal proportions is used to make SBS board. The mix is varied according to desired strength, density, and printability. Softwood content is higher for liquid packaging, for example, because of superior tear and tensile strength properties.

Bleached board is generally made on a conventional fourdrinier paper machine, a flat-forming suction type, with a secondary headbox commonly included to improve sheet formation and smoothness. Limited use is made of multi-fourdrinier paper machines in North America, but several liquid packaging producers have recently converted their machines to produce a multi-ply board.

A multi-fourdrinier machine combines a series of separate fourdrinier sections and headboxes on a single machine to produce a multi-ply board that has superior stiffness and less weight than a single-ply board. Also, a multi-ply board may contain mechanical pulp in the middle ply. For example, the top and bottom layers are made from hardwood and softwood bleached kraft (or sulfite) pulp, and the middle ply is made from chemi-thermomechanical pulp (CTMP) or thermomechanical pulp (TMP). The cost is generally lower due to the use of lower-cost groundwood pulp.

Multi-fourdrinier machines have been successfully operated for several years in Europe, but they have only recently been accepted in North America. Continental Forest Industries Inc. installed a new multi-ply machine at its Augusta, Ga., mill in 1978, but the mill experienced severe operating problems with the Voith equipment. The mill was sold in 1985 to Federal Paper Board Co. Inc. In late 1990, Federal completed a project to convert the mill's No. 3 machine to produce 100% single-ply bleached kraft SBS paperboard with about 400 tpd of additional capacity.

In 1988, Cascades Inc. converted an older cylinder board machine at its Jonquière, Que., mill to a three-fourdrinier machine using Ahlstrom/Valmet technology. The Cascades machine uses TMP and bleached kraft pulp to produce a double-white, three-ply board that could replace SBS in packaging applications.

In 1990, Tembec Inc. started up a new Tampella three-fourdrinier machine at its Temiscaming, Que., mill. Tembec's new machine will produce 140,000 metric tpy of low-density, coated three-ply bleached paperboard using a combination of CTMP and sulfite pulp. In the U.S., Weyerhaeuser Co., Potlatch Corp., and International Paper Co. have upgraded their existing liquid packaging board machines by installing new twin-wire systems and dual-channel headboxes to produce a low-density, multi-ply board with improved sheet formation, smoothness, stiffness, and printing characteristics.

INDUSTRY STRUCTURE

Bleached paperboard is manufactured by 13 major suppliers in the U.S. and by three in Canada. U.S. capacity is fairly concentrated, with the top five producers accounting for approximately 65% of industry capacity. International Paper, Federal Paper Board, and Westvaco Corp. are the three largest producers. Most SBS producers have recently increased or plan to increase capacity, mostly through productivity improvements or incremental machine upgrades. Only Westvaco is planning a new machine.

Westvaco has announced plans to add a new, $400-million SBS board machine at its Covington, Ky., mill. The new machine will have capacity of 350,000 tpy when it begins operation in late 1993 or early 1994. The new machine represents the largest SBS expansion in the industry since Westvaco installed a new 175,000-tpy machine at Covington in 1986. The new SBS machine is expected to produce 600 tpd at startup but will have the capability to expand to about 1,000 tpd.

Gulf States Paper Corp. plans to increase the bleached pulping capacity of its Demopolis, Ala., mill in anticipation

U.S. BLEACHED BOARD PRODUCTION BY END USES[1]

(000 short tons)

Year	Total	Cartons		Heavyweight cup stock	Plate, dish, and tray	Linerboard	Other food packaging	Miscellaneous packaging[2]
		Folding	Milk					
1989	4,906	2,212	1,143	426	323	445	284	73
1988	4,973	2,245	1,092	500	274	523	280	59
1987	4,636	2,023	1,116	486	270	404	281	55
1986	4,535	2,076	1,226	442	276	121	348	45
1985	4,282	1,955	1,227	422	245	(D)	404	29
1984	4,104	1,895	1,092	455	225	118	288	31
1983	3,988	1,901	1,060	440	252	113	191	31
1982	3,757	1,743	1,052	418	227	101	184	32
1981	4,070	1,981	1,085	427	245	120	223	49
1980	4,026	2,063	1,015	401	263	—	—	40
1979	3,883	1,999	1,090	341	232	102e	—	119
1978	4,002	1,934	1,048	400	277	159e	—	184
1977	3,882	1,822	1,040	419	296	92	53	160
1976	3,876	1,880	1,050	370	267	103	23	183
1975	3,420	1,540	1,052	329	274	88	—	137
1974	3,827	1,706	1,055	442	322	104	—	198
1972	3,741	1,637	1,006	389	350	139	—	220
1970	3,404	1,395	971	369	317	133	—	219

(D) = Data withheld to prevent disclosure of figures for individual companies.
e = Estimate.
1. Production for both foreign and domestic uses.
2. Includes other food packaging when not included in separate category 1970-79.
Source: Bureau of the Census, not comparable with American Paper Institute data series.

of adding a new SBS machine in the mid-1990s. The pulp mill expansion will double Gulf States' current capacity of 750 tpd of bleached kraft pulp. The company will increase its output of market pulp until a final decision is made concerning the addition of a new SBS machine.

Federal significantly expanded its market share in 1985 with the acquisition of Continental Forest's Augusta mill, which complements Federal's Riegelwood, N.C., bleached board mill. Jefferson Smurfit Corp. entered the bleached board segment in 1986 when it acquired ownership of Container Corp. of America's Brewton, Ala., mill. Georgia-Pacific Corp. doubled its SBS production capacity in 1988 when it purchased Brunswick Pulp & Paper Co. in Brunswick, Ga., a former joint venture of Mead Corp. and Scott Paper Co.

Swing capacity. Some companies that produce bleached packaging paperboard grades also produce lightweight bleached printing bristols and bleached kraft pulp on the same paper machines. This allows producers to adjust, or swing, production between grades in response to market conditions and perhaps take advantage of more profitable markets. However, many mills prefer to remain consistent with their grade mix unless markets change substantially. Also, very little swing capacity is available when SBS board supply is tight.

In the early 1980s, as much as 200,000 to 300,000 tons of bleached pulp were produced annually on bleached board machines. Most of this pulp was not papermaking chemical-grade bleached pulp; rather, it was highly absorbent fluff pulp used in the manufacture of disposable diapers and other sanitary products. This fluff pulp was shipped in rolls rather than baled.

Requirements for fluff pulp have become more specialized, and overall growth in demand has slowed due to the introduction of superabsorbents. Furthermore, two leading producers of fluff pulp that also produce bleached board—Weyerhaeuser and International Paper—have shifted production from swing machines to dedicated facilities.

American Paper Institute data show that pulp produced on SBS machines steadily declined from 97,600 tons in 1984 to 54,000 tons in 1985, 27,915 tons in 1986, 41,473 tons in 1987, 15,005 tons in 1988, and 8,200 tons in 1989. Less than 5,000 tons were produced in 1990-91. The rising demand for SBS packaging board and surplus capacity of market pulp hastened the shift in grade mix to favor SBS board.

In addition to reducing swing capacity, producers have also lowered the basis weight and density of SBS boards. A lower-density board with stiffness and quality comparable with higher-density board of several years ago is now possible. The result is more units of product per ton of board. Upgrading the printing quality of folding carton board is another trend in the U.S. market. Examples are Westvaco's premium-grade Printkote Hi-Gloss stock and IP's Val-U-Coat board.

From 1970 to 1979, bleached board capacity grew at a 1.7% annual rate, but it declined 1.9% during 1979-84, according to API figures. In 1985, however, capacity began to creep up again, rising from 4.37 million short tons to 4.84 million tons in 1990. Capacity is expected to grow at about

U.S. BLEACHED BOARD PRODUCTION

Year	Tonnage (000 short tons)	Change (%)
1990	4,399	-2.7%
1989	4,521	0.2
1988	4,511	7.2
1987	4,406	4.7
1986	4,207	7.6
1985	3,911	-2.5
1984	4,011	3.0
1983	3,895	6.9
1982	3,644	-6.2
1981	3,886	1.3
1980	3,836	-3.4
1979	3,973	0.5
1978	3,955	6.8
1977	3,703	-3.1
1976	3,820	14.9
1975	3,324	-11.4
1974	3,752	-2.3
1973	3,842	4.8
1972	3,667	9.0
1971	3,363	1.1
1970	3,327	-6.5
1969	3,560	—

Source: American Paper Institute.

CAPACITY FOR BLEACHED PACKAGING BOARDS OF MAJOR U.S. COMPANIES

Company	Annual capacity (000 short tons)	Capacity share (%)
1. International Paper	905	18.7%
2. Federal Paper Board	680	14.0
3. Westvaco	620	12.8
4. Potlatch	554	11.4
5. Georgia-Pacific	370	7.6
6. Temple-Inland	300	6.2
7. James River	270	5.6
8. Champion International	265	5.5
9. Gulf States Paper	230	4.8
10. Weyerhaeuser	230	4.8
11. Gilman Paper	200	4.1
12. Jefferson Smurfit/CCA	185	3.8
13. Union Camp[1]	140	n.a.

Capacity share of top five companies: 64.6%
Capacity share of top ten companies: 91.4%
Total U.S. capacity (1991):
4.843 million short tons

n.a. = Not available.

[1] Includes more than 50% swing capacity for bleached bristols.

a 3.3% annual rate between 1990 and 1992, reaching 5.1 million tons in 1992.

The primary cause for the jump in capacity between 1985 and 1986 was the startup of a new, 175,000-tpy SBS machine at Westvaco's Covington mill. However, some of this capacity was offset by the shutdown of a smaller, older machine at the same facility. API initially projected more substantial capacity gains in the late 1980s, but several companies stretched out expansion plans for their mills.

The majority of the 27 bleached paperboard machines in the U.S. are located in the Southeast. Most range in capacity size from 150,000 to 250,000 annual tons, and more than half were installed or rebuilt after 1970. Companies have also improved the efficiency of their mills in recent years through new labor rules and capital spending projects. Several producers, such as Federal Paper Board, Potlatch, International Paper, and Temple-Inland Inc., have also undertaken major energy conservation projects at their mills.

From 1976 to 1985, bleached board production rose at about a 1.5% annual rate. The weak performance was due to lower domestic demand for milk cartons in favor of plastic containers, competition from plastics in the food-service segment, and slower export growth. Another factor that held back SBS tonnage growth was a trend toward reduced basis weights, especially for folding cartons.

Since 1986, demand for SBS has been very good. Total U.S. production of bleached board in 1986 was up 8.7% to 4.29 million tons after a drop of 2.5% to 3.95 million tons in 1985. In 1987, production again rose, moving up 3.2% to 4.4 million tons, and in 1988 it hit a record 4.51 million tons. Operating rates rose to 94.5% in 1987 and 95.3% in 1988. But in 1989, production increased by only 0.5% to 4.52 million tons because all available production capacity was utilized and the industry was capacity constrained. In 1990, production declined by 2.7% to 4.4 million tons because of several major machine rebuilds that reduced available production capacity. In 1991, production swung back to about 4.6 million tons.

During the past decade, U.S. bleached board exports have grown at a 6% to 7% annual rate, representing between 12% and 14% of total U.S. production. From a cyclical peak of 557,000 tons in 1981, however, SBS production for export declined steadily to a low of 466,000 tons in 1985. The decline reflected the impact of the strong dollar and increased competition in Europe from Scandinavian producers. But as the dollar weakened, exports jumped 22% to 569,000 tons in 1986 and increased further to 619,000 tons in 1987. Exports increased to 628,000 tons in 1988 and then jumped to 693,000 tons in 1989. In 1990, exports reached 732,000 tons. Milk carton stock accounts for about 75% of SBS exports, with the remaining 25% mostly folding carton stock.

Strong price trend. The price of SBS, which fluctuates with market conditions, has strengthened each year since 1986. Prices deteriorated between 1981 and 1985, except for a brief recovery in 1984 when some producers got as much as $645 to $665/short ton for 15-pt clay-coated folding carton stock. In 1981, the list price was a firm $625, which was eroded by discounting in 1985 to between $500 and $590, severely squeezing profitability.

Prices strengthened when market demand recovered in 1986. Producers raised prices an average of two times/year during the 1986-89 period. End-of-year prices for 15-pt clay-coated folding carton stock were approximately $580/ton in 1986, $635/ton in 1987, $730/ton in 1988, and $830/

U.S. CAPACITY FOR BLEACHED BOARDS

(000 short tons)

Year	Linerboard	Folding	Milk carton and food service	Other	Total	Change (%)
1993e	161	2,789	2,058	281	5,289	4.6%
1992e	159	2,638	1,989	271	5,056	4.4
1991e	175	2,484	1,915	269	4,843	4.8
1990e	192	2,309	1,856	261	4,619	-2.1
1989	194	2,298	1,961	263	4,716	-0.4
1988	170	2,323	2,017	222	4,733	1.2
1987	148	2,309	2,031	191	4,679	2.3
1986	135	2,341	1,926	175	4,576	4.7
1985	131	2,223	1,843	173	4,370	4.4
1984	119	2,095	1,771	200	4,185	2.1
1983	104	2,020	1,758	217	4,100	-3.0
1982	104	1,988	1,812	219	4,123	2.7
1981	108	1,904	1,774	229	4,015	-4.0
1980	116	1,954	1,865	246	4,180	-3.2
1979	133	2,080	1,916	189	4,318	2.9
1978	122	1,996	1,899	179	4,197	4.4
1977	97	1,930	1,824	170	4,020	0.6
1976	101	1,915	1,854	128	3,998	5.0
1975	95	1,751	1,859	102	3,807	-2.9
1974	108	1,851	1,848	113	3,920	-0.2
1973	141	1,749	1,899	139	3,928	3.7
1972	134	1,583	1,937	134	3,788	6.1
1971	143	1,455	1,842	128	3,569	2.8
1970	130	1,406	1,739	197	3,472	-2.4
1969	150	1,500	1,689	218	3,557	—

e = Estimate.
Source: American Paper Institute.

ton in 1989. In 1990, producers were unable to raise prices because a large amount of production capacity was offline for machine rebuilds. But producers successfully raised prices by $40/ton in mid-1991 to a record level of $870/ton.

MARKETS

Folding cartons are the largest end use for SBS board, accounting for approximately 51.3% of machine production capacity in 1990. Milk carton stock and disposable food-service packaging makes up about 39.5% of the market, bleached linerboard is about 3.6%, and other packaging and nonpackaging stock (including blister packaging, graphic boards, and ovenable paperboard) is 5.6%.

The U.S. folding carton market is mature, but demand has grown about 3% annually since 1986, and SBS has maintained about a 38% share of the domestic market. API statistics for 1988 show total domestic folding boxboard production at 5.3 million tons, of which 2.35 million tons was recycled boxboard (44.4%), 2.02 million tons was SBS (38.2%), and 924,000 tons was unbleached kraft boxboard (17.4%). In 1990, when SBS output declined, the total domestic market was 5.2 million tons, with 2.4 million tons of recycled (46.4%), 1.8 million tons of SBS (35.0%), and nearly 1 million tons of unbleached kraft (18.7%).

U.S. BLEACHED BOARD EXPORTS[1]

(short tons)

Year	API[2]	Census
1990	732,000	765,000
1989	693,000	795,305
1988	628,000	743,000
1987	619,000	648,000
1986	569,000	571,000
1985	466,000	518,000
1984	478,000	543,000
1983	514,000	558,000
1982	525,000	526,000
1981	557,000	584,000
1980	545,000	560,000
1979	466,000	490,000
1978	430,000	440,723
1977	389,000	374,823
1976	306,000	352,638
1975	—	284,203
1974	—	374,642
1973	—	265,169
1972	—	208,516
1971	—	183,257
1970	—	129,139
1969	—	131,946

1. Imports are minor.
2. American Paper Institute data represent production for export, not shipments.

The fastest growth in the folding carton market has been achieved by clay-coated unbleached kraft grades, which have nearly doubled their market share since 1972. Coated unbleached kraft grades not only offer greater strength than recycled boxboard and cost less than SBS but also will probably continue to increase their share of the market (see Coated and Uncoated Kraft board chapter). Prices for coated unbleached kraft folding carton grades fall between those for SBS and recycled grades.

In addition to the growing popularity of coated kraft grades, another competitive factor for SBS is the widening price gap with clay-coated recycled boxboard. The price differential between SBS and clay-coated recycled newsback folding carton board was about $325/ton in mid-1991. The price differential in the early 1980s was between $150 and $200/ton. However, because of higher yield on an area basis due to lower density in bleached board, the extreme price differential between the two grades is somewhat reduced in the converting process.

SBS producers convert about 50% of their folding carton board output in their own manufacturing plants. The largest integrated SBS folding carton producers are International Paper, James River Corp., and Westvaco. The largest suppliers of SBS to independent folding carton converters are Federal Paper Board, Temple-Eastex Inc., Potlatch, Georgia-Pacific, and Gilman Paper Co. Federal sold three carton plants in 1991 but still operates four converting facilities.

Folding carton profits have been poor for several years because prices for converted folding cartons have not kept pace with the rapid rise in SBS board prices. As a result, Champion International Corp., Temple-Eastex, and Potlatch have all divested their folding carton plants in recent years, while IP and Federal have closed or sold some unprofitable folding carton plants.

Liquid packaging board. U.S. demand for liquid packaging board has fluctuated during the past two decades. Production rose in the early 1970s but declined over the next 15 years. Domestic milk carton production fell almost steadily from 941,000 short tons in 1970 to 591,000 tons in 1982. In 1983, however, production was up 2.7% to 607,000 tons, and it rose 6.3% in 1984 to 645,000 tons. In 1985 and 1986, production fell to 609,000 tons and 591,000 tons, respectively. In 1987, production rebounded again to 624,000 tons and then slipped to 606,000 tons in 1988. In 1989, production for domestic U.S. fell to 588,000 tons, but it rose again in 1990 to 617,000 tons.

In 1985-86, liquid packaging board accounted for about 15% of sales within the sanitary food container industry, compared with 20% in 1972, according to the U.S. Dept. of Commerce (DOC). Most of paperboard's loss of market share in milk packaging has been in the gallon and half-gallon sizes, mainly in the Midwest and West. By 1980, most of the gallon-size segment had been lost to plastics. Continued losses in the half-gallon segment are still a concern. Some forecasts expect plastic to capture as much as 50% of the market currently held by paperboard in the half-gallon segment.

According to the Dept. of Agriculture, paperboard's total share of fluid milk packaging shifted from 78% in 1971 to 31% in 1989, the last year for which this data is available. During that time, the market share of plastic containers (mostly high-density PE) went from 15% to 69%. Of the gallon containers sold for fluid milk packaging in 1989, 99.3% were plastic and only 0.7%% were paperboard. In the half-gallon sizes, 27.8% were plastic and 71.3% were paperboard. In the smaller sizes, paperboard still had approximately 97% to 99% of the market.

Besides competition from plastics, carton use is depressed because of modest growth in domestic milk consumption. In 1989, 53.666 billion lb of milk were consumed in the U.S., almost unchanged from the previous year and only 1.2% higher than 1980 consumption. From 1972 to 1982, domestic milk consumption steadily declined, but it has since turned around, largely because of a small "baby boom" among young families.

Although carton use for milk packaging has declined, other types of liquid packaging are growing. This is especially true for juice and juice derivatives and even wine. The Paperboard Packaging Council (PPC) estimated that juice and juice-drink cartons comprised 25% of the market in 1988, compared with about 5% ten years earlier. Paperboard cartons are also being used to package nondairy beverages as well as dry foods, pet foods, and various nonfood items, according to the U.S. Bureau of Industrial Economics.

For its part, PPC has fought further deterioration in the paperboard carton market with a campaign started in 1982 to publicize the nutritional advantages of milk packaged in paperboard instead of plastic. The promotion appears to be working. In 1983-84, domestic milk carton consumption was up for the first time since 1975. It slipped again in 1985 to the same level as in 1983, but this was attributed by some industry experts to a temporary halt in the PPC campaign when it was challenged by the plastics industry. The promotion was resumed in 1986 and ran through 1988.

Other promotions begun in recent years could also have increased milk carton sales. The paperboard gallon two-pack was introduced by International Paper as an alternative to the plastic gallon jug. Another promotion, begun in 1985, features photographs and descriptions of missing children on side panels of milk cartons, an idea later extended to paper cups. However, this campaign was losing popularity by early 1990.

The most recent marketing development has been the creation of multi-ply barrier cartons that extend the shelf life and freshness of milk and other beverages. IP, Westvaco, and Potlatch have all developed their own versions of these high-tech cartons. These same companies have also developed cartons that feature a reclosable plastic pour spout to improve consumer convenience.

For all practical purposes, the domestic milk carton sector is 100% integrated from the manufacture of paperboard to the manufacture of cartons. IP and Champion International are the largest producers of milk carton blanks, which are shipped flat to dairies. The other integrated producers are Potlatch and Westvaco. The fifth largest U.S. producer of milk carton stock is Weyerhaeuser, which sold its Vancouver, Wash., milk carton plant to a subsidiary of AB Tetra Pak in mid-1989. In late 1989, IP expanded its integrated manufacturing operations in Canada when it purchased the Pure Pak packaging operations of Somerville Packaging.

Exports of milk carton packaging have shown strong growth, averaging about 5% annually in recent years. In 1990, an estimated 508,000 tons, or 45%, of total milk car-

U.S. PRICES FOR BLEACHED KRAFT BOARD

($/short ton)

Year	15-pt, folding carton, C1S 80 bright (rolls)	Heavyweigt cup stock, uncoated
1991		
3Q	$870/880	$750/800
2Q	830/840	n.a.
1Q	830/840	n.a.
1990		
4Q	830/840	750/800
3Q	830/840	n.a.
2Q	830/840*	n.a.
1Q	830/840	n.a.
1989		
4Q	830/840	750/800
3Q	830/840	n.a.
2Q	780/790	n.a.
1Q	780/790	n.a.
1988		
4Q	730/740	675/700
3Q	730/740	n.a.
2Q	665/700	n.a.
1Q	625/660	n.a.
1987		
4Q	625/660	625/650
3Q	600/645*	n.a.
2Q	590/645*	n.a.
1Q	570/625*	n.a.
Year end		
1986	570/625*	556
1985	(500/590)	507
1984	590/665*	584
1983	590/625*	565
1982	590/625*	507
1981	625	584
1980	550	565
1979	490	570
1978	425/445	581
1977	405	482
1976	385	457/468
1975	360/365	406
1974	360	386
1973	300	364
1972	265	342

Note: Prices generally higher on the West Coast.
*Discounting from list prices reported.
n.a. = Not available.
( ) = Indicates estimated transaction prices where most volume is moving significantly below list.
Source: *Pulp & Paper Week*.

ton production was exported. IP, Potlatch, and Weyerhaeuser are the major U.S. exporters of milk carton stock. The two other major U.S. producers, Champion International and Westvaco, do not export any significant amount of milk carton stock. U.S. producers are very competitive with Swedish and Finnish producers in worldwide liquid packaging markets, and these two producing regions dominate the worldwide supply of paperboard liquid packaging.

Aseptic liquid packaging. This innovative multi-ply packaging system has expanded rapidly in the U.S. since its introduction about five years ago. Estimates place the number of aseptic cartons sold in the U.S. at between 4.5 and 5.0 billion units, mostly in the 250-mil size. However, the volume of liquid packaging board used for such aseptic packaging in the U.S. is still small, probably under 25,000 tons annually. In addition, some aseptic packaging is still imported from Scandinavian producers. The existence of imports in this market reflects the fact that the largest aseptic packaging converter in the U.S. is a subsidiary of AB Tetra Pak, a $2-billion Swedish company with an estimated 90% share of the world market.

AB Tetra Pak has installed nearly 5,800 proprietary packaging machines in 102 countries, and it operates 26 packaging material factories, six machine assembly plants, and 47 marketing companies worldwide. In 1988, some 50 billion Tetra Pak cartons were produced, equal to about 135 million cartons/day.

Aseptic cartons use advanced coextrusion technology to produce a shelf-stable package requiring no refrigeration to retain product freshness and quality. The cartons combine specially treated paperboard with plastic film and aluminum foil or other combinations. It is not necessary to use solid bleached board in this configuration. In fact, most Tetra Pak cartons use a multi-ply sheet with a middle ply of unbleached kraft pulp.

Aseptic packaging systems require sterilization and an extremely clean working site. The aseptic packaging laminate is sterilized with either a special hydrogen peroxide bath, high heat, or steam. After filling, the cartons require little or no refrigeration. They have greatly extended shelf life and are compact and convenient to carry and store. In short, the package is designed to save more than it costs to produce. Aseptic containers are used to package soft drinks, juices and juice concentrates, gelled foods, baby foods, sauces, pastes, gravies, and puddings. Attempts have been made to market aseptically packaged milk in the U.S., but dairies are having difficulty breaking consumer perceptions that milk must be refrigerated to remain fresh.

Aseptic packaging was developed in Europe and approved by the U.S. Food & Drug Administration in 1982. Most aseptic packaging comes from its original inventor, AB Tetra Pak. Its U.S. subsidiary, based in Texas, is Brik Pak Inc. Combibloc Inc., controlled by a West German company, is the second-largest manufacturer, followed by a relative newcomer, International Paper.

In 1987, IP entered into a joint agreement with SIG Swiss Industrial Co. to market in North America the new SIG high-speed aseptic packaging system. Since then, IP has developed a special Barrier Pak multilayer paperboard for use in aseptic packaging, and it produces this packaging at a new, state-of-the-art facility in Raleigh, N.C. This facility can produce a five-layer coextrud-

U.S. SANITARY FOOD CONTAINERS INDUSTRY: VALUE OF SHIPMENTS AND CONSUMPTION OF PAPER AND BOARD

	1982		1987	
	Paper and board consumed (000 short tons)	Value of products (million $)	Paper and board consumed (000 short tons)	Value of products (million $)
Total: (SIC Code 2654)	—[1]	$2,545.6	—[1]	$1,940.6
Milk and milk-type cartons[2]	569	550.0	526.5	557.5
Cups and liquid-tight containers	—	885.0	—	848.5
Liquid-tight containers[3]	32	64.0	24.2	61.3
Drinking cups[4]	451	821.0	459	786.6
Cups[5]	—	0.1	—	0.6
Other sanitary food containers[6]	—	356.0	—	457.9
Food serving products				
Stamped plates, dishes, spoons	227	259.0	202	273.2
Ovenable food trays	—	—	15	37.3
Other paperboard items	32	63.0	30	22.7
Other paper items[7]	—	—	—	112.4
Frozen foods and bakery[8]	196	229.0	297	360.0
Butter and ice cream packaging and food pails	155	170.0	209	258.2
Processed meats, margarine[9]	83	106.0	70	96.1
Others[10]	—	42.0	—	50.0

1. Data not collected or available.
2. Including juices, beverages, and other products.
3. Plus round nested food containers, including lids and tops.
4. Plus portion serving cups.
5. And liquid-tight containers not classified.
6. Includes food containers, boards, and trays.
7. Includes tablecloths and soda straws, except glass or plastic.
8. Including frozen bakery.
9. Plus lard and shortening.
10. For fresh meat, poultry, and produce for retail packaging.

Sources: 1982 Census of Manufactures, 1987 Census of Manufactures.

ed sheet for cold-fill products or a six-layer sheet for hot-fill products. IP now sells its aseptic board in over 20 countries. The bleached paperboard is supplied by the company's mills at Pine Bluff, Ark., Texarkana, Texas, and Bastrop, La.

Forecasts of aseptic packaging growth in this country are quite optimistic. In a 1986 report, for example, Business Communications Co. (BCC) projected an annual growth rate of 10% for the aseptic food and beverage market during the following ten years. Total production of aseptic food/beverage containers was expected to reach 12.2 billion units in 1995, or about 4% of the entire food/beverage packaging market. At the time of the report, aseptic containers totaled about 4.5 billion units annually, or 1.5% of the 313-billion-unit food/beverage market. Juices and juice products will remain the largest market segment through 1995, although other new products packaged aseptically will show higher real growth rates.

Aseptically packaged dairy products, such as sour cream and individually packaged cream, will gain wider acceptance over the next few years. But consumer preference for refrigerated milk will continue to thwart expansion of that product in aseptic packages, according to BCC. The BCC study noted that viscous and particulate products will be the most attractive new additions to the aseptic food/beverage line. The first real challenge to metal and glass packaging will come from the introduction of aseptic processing equipment and fillers that can preserve particle integrity, such as for soup.

Ovenable paperboard. The performance of ovenable paperboard, another innovative package system, has failed to match industry expectations, but it remains another leading-edge technology for the bleached paperboard industry. This type of paperboard, which can be used in both microwave and conventional ovens, has undergone many improvements in structure and design since its introduction in the 1970s. Ovenable paperboard is typically made by coating SBS with a polyethylene terephthalate resin and pressing or diecutting the SBS sheet into trays.

FLUID MILK SALES BY PACKAGE SIZE AND TYPE*

Container size	Total sales (million lb)	Type of container (% of total sales) Glass	Paper	Plastic
Gallon	2,209.9	<0.1%	0.7%	99.3%
Half-gallon	753.7	0.9	71.3	27.8
Quart	160.8	0.6	97.3	2.1
Pint	58.1	<0.1	96.7	3.3
Half-pint	344.6	<0.1	99.3	0.7
Total	3,617.7	<0.2	31.0	68.8

*Sales for November 1989 by handlers regulated in Federal Milk Order markets. Represents 75% of U.S. handlers. Total includes some container sizes not shown.
Source: U.S. Dept. of Agriculture.

While use of microwave ovens has increased dramatically, the current size of the ovenable paperboard market in the U.S. may still be less than 20,000 tpy, according to some estimates. One reason for the modest growth of ovenable paperboard is the development of an all-plastic tray that has been widely accepted by the frozen-food industry. Nevertheless, demand for ovenable paperboard grew at about a 6% annual rate during the past several years, according to DOC. The increasing popularity of oven-ready meals and single-portion servings should continue to provide growth for paperboard in this market. Westvaco's Ovenware package, which goes directly from freezer to microwave or oven, has been accepted by consumers and packaged-food companies alike.

Food-service disposables. As with liquid packaging, bleached board is facing heavy competition from plastics in the disposable-food-service segment. While dollar sales of converted trays, plates, cups, and nested and liquid-tight containers have remained fairly stable, unit volume of such paper products has probably declined, according to DOC. In an attempt to counter competition from plastics, the industry has concentrated on improving the strength, appearance, and design of its cups and other food-service products. Companies have also emphasized paperboard's environmental benefits when compared with plastic products.

According to API statistics, production of bleached paperboard cups, plates, trays, and rounded nested food containers was relatively stable during the last decade. Production of bleached paperboard used to manufacture these products totaled 845,000 tons in 1990, about a 1.0% decline from the year before due to weak markets for vending cups. Paperboard disposables have enjoyed some market gain in the past year because plastic disposables have been criticized as being damaging to the environment.

Regardless of the environmental issues, plastic disposables have been able to capture about 60% of the beverage cup market and an even higher share of the plate market, according to some industry estimates. Weak plastic resin prices in 1985-86 helped some integrated resin producers, such as Mobil Corp. and Amoco Corp., gain market share, but the run-up in plastic resin prices between 1987 and

PERCENT OF FLUID MILK SALES* BY PACKAGE TYPE

Year	Glass	Paper	Plastic	Other
1989	<0.2%	31%	69%	<0.1%
1987	<0.5	33	67	<0.5
1985	<0.5	35	65	<0.5
1983	<0.5	38	62	<0.5
1977	1.0	58	41	<0.5
1971	7.0	78	15	<0.5
1966	25.0	67	6	2.0
1963	32.0	63	n.a.	5.0

n.a. = Not available.
*Represents total fluid milk, including whole, lowfat, and skim.
Source: U.S. Dept. of Agriculture.

CONVERTED BLEACHED BOARD PRICES

(BLS price index)

Year	Milk and milk-type containers[1]	Cups and liquid-tight containers[2]	Bleached packaging and industrial converting paperboard[3]
1991			
2Q	412.8	141.2	135.4
1Q	398.5	140.9	135.4
1990			
4Q	395.8	139.4	135.4
3Q	395.8	136.7	135.4
2Q	383.6	135.2	131.0
1Q	377.8	135.2	130.1
1989			
4Q	375.4	135.2	135.4
3Q	377.0	135.3	134.5
2Q	362.5	129.3	130.1
1Q	355.0	129.6	129.8
1988			
4Q	349.4	121.2	122.8
3Q	354.1	113.4	115.5
2Q	345.6	113.3	113.6
1Q	339.5	109.3	106.9
1987			
4Q	334.7	109.3	106.9
3Q	336.8	109.3	106.8
2Q	337.5	106.7	107.3
1Q	332.9	105.2	108.7
1986			
4Q	334.3	105.0	108.3
3Q	336.6	102.0	107.3
2Q	332.7	100.6	106.2
1Q	333.3	100.1	105.9
Year end			
1985	335.9	100.2	107.7
1984	314.0	231.0	109.3
1983	302.5	220.0	103.0
1982	275.8	220.0	—
1981	257.5	220.0	—
1980	220.8	197.1	—
1979	199.0	180.1	—
1978	185.0	148.1	—
1977	180.7	140.2	—
1976	169.3	132.6	—
1975	157.7	126.7	—
1974	145.0	125.6	—
1973	109.3	106.4	—
1972	106.7	103.3	—
1971	102.0	103.3	—
1970	99.8	98.8	—

1. Listed as "Milk Cartons, Gal." prior to July 1985.
2. June 1985 = 100; 1967 to June 1985 = 100 (per 1,000). Listed as "Paper cups, hot" prior to June 1985.
3. December 1982 = 100; *Pulp & Paper* estimates 1990-91.

Sources: U.S. Dept. of Labor, Bureau of Labor Statistics, Producer Prices and Price Indexes.

1989 reduced their profits for these products. In general, plastic food-service products cost 25% to 30% less than their paper counterparts.

Bleached paperboard has performed best in the larger-size cold-service cups, while plastic foam cups and trays have made their largest inroads in the hot-service area. Plastic has also made significant gains in nested and other liquid-tight containers. Thermo-formed plastic containers, for example, have taken over much of the market for dairy products such as cottage cheese and yogurt.

Plastic food-service disposables have drawn the wrath of environmental activists because they are neither biodegradable nor widely recycled and because toxic byproducts are produced during their manufacture. Although the plastic industry has responded by changing the chemical composition of its products and by recycling more of its waste, many communities and state governments still want to ban the products. In late 1990, McDonald's Corp. announced plans to eliminate plastic foam packaging in all of its restaurants, delivering a severe blow to the plastics industry's struggling recycling efforts.

Temple-Inland Forest Products Corp. (formerly Temple-Eastex) is the largest producer of cup and plate stock, but it has no converting facilities and sells all of its mill production to independent converters. James River is the major integrated producer of both paper and plastic food-service products through its Marathon and Dixie lines. Federal

SUMMARY OF SANITARY FOOD CONTAINER INDUSTRY STATISTICS (SIC Code 2654)

Year	Plants (total)	Employees	Value of shipments[1] (million $)	Capital expenditures (million $)
1990e	—	18,500	$2,825	—
1989e	—	18,500	2,757	—
1988e	—	17,900	2,447	$85.2
1987	92	15,800	2,083	95.5
1986	—	24,700	2,806	142.6
1985	—	23,400	2,853	112.5
1984	—	22,800	2,750	64.6
1983	—	23,600	2,686	78.5
1982	145	24,600	2,556	67.1
1981	—	28,300	2,627	70.7
1980	—	28,400	2,700	56.0
1979	—	29,800	3,116	65.7
1978	—	28,900	3,161	71.5
1977	193	28,700	3,258	52.4
1976	—	30,600	3,330	53.8
1975	—	28,300	3,151	29.6
1974	—	—	3,365	44.5
1973	—	—	3,424	38.0
1972	251	35,100	3,461	42.3
1971	—	—	—	33.8
1970	—	—	—	39.8

1. Value of industry shipments, not products, in 1982 dollars.

Source: Census of Manufactures.

Paper Board sold its plate-converting operations to the Fonda Group in 1985 but reentered the business in 1989 when it purchased Imperial Cup Corp. In 1990, Federal acquired the assets of Continental Bondware, a major producer of paper cups and disposables. Fort Howard Corp. was formerly the largest independent converter and marketer of disposable paper and plastic products with its Maryland Cup and Lily-Tulip operations, but these businesses were sold to Silgan Corp. in 1989.

OUTLOOK

Analysts expect the bleached board market to resume expansion as new production capacity is added in 1990-91. In 1988-89, most mills were fully sold out and turning away new business. According to one analyst, total SBS folding carton production could reach 2.5 million tons in 1992-93, after a weak performance in 1989-90 caused by supply constraints. Domestic milk carton and food-service disposables should increase to 1.5 million tons, and exports should increase to about 800,000 tons. Total SBS production is forecast to reach 4.6 million tons in 1991 and 4.7 million tons in 1992.

The long-term forecast for folding carton stock remains optimistic because of increasing demand for packaging and increasing emphasis on printing and graphics. The continuous introduction of new consumer products spurs demand for folding cartons. Although food packaging remains the largest market for folding cartons, market growth is also coming from consumer electronic products, music compact discs, video and computer software packaging, etc. In addition, the increase in microwave oven sales has expanded the market for prepared microwave foods, which are mostly packaged and sold in folding cartons. Greater emphasis on personal health has also opened up new packaging opportunities in health care products.

Provided that consumers continue spending approximately the same amount of their income on packaged foods and disposable food-service products, DOC expects the real value of sanitary food container shipments to climb about 2% in 1990 and 1991—about the same as in 1989. Sales of aseptically packaged juices and other drinks are expected to continue expanding; however, aseptic milk shipments should grow more slowly, constrained by hard-to-change consumer buying habits and tastes, according to DOC.

For the 1987-91 period, the DOC forecast calls for an average annual growth rate of about 2.2% for sanitary food container shipments, provided there is gradual improvement in retail food sales as well as continued growth in fast foods and convenience foods.

Aseptic and microwave containers will continue to be the packaging industry's growth leaders. New food-packaging materials will appear, especially barrier plastics (coextruded, multilayer plastic containers that extend nonrefrigerated shelf life for a variety of food products, such as juices and sauces) and retortable, flexible, food-filled plastic bags, which also extend nonrefrigerated shelf life and are especially geared to packaging solid foods.

Plastics will play an increasing role in the construction of the aseptic package, sometimes displacing paperboard and foil completely. Sales of ovenable paperboard trays will continue rising, but plastics will likely provide increasing competition in this packaging sector.

Export shipments of U.S. bleached board should continue growing faster than domestic demand. However, increased use of aseptic packaging in various parts of the world may favor Scandinavian producers, particularly in Europe. Most future growth for U.S. exports will be in Asia, which now accounts for about 70% of U.S. milk carton shipments.

Paperboard:

RECYCLED

Recycled paperboard typically consists of 100% wastepaper fiber and is produced on either a cylinder or fourdrinier paper machine. As a general rule, recycled board mills tend to be older, smaller, and less efficient than those found in other sectors of the industry, but this trend is changing as companies invest in machine modernization and other capital improvements. The average size of recycled paperboard machines in the U.S. is about 140 tpd, compared with about 490 tpd for bleached paperboard mills and 750 tpd for unbleached kraft board mills. However, recycled mills are usually located closer to their customers and fiber sources, thereby reducing shipping and materials costs and enabling the mills to provide quick response to customer orders.

Recycled paperboard includes such diverse grades as boxboard, containerboard, gypsum wallboard, and various types of industrial converting grades. Production capacity by major grade in 1991 breaks down as follows: folding boxboard, 25.7%; setup boxboard, 3.0%; corrugating medium, 22.3%; gypsum wallboard, 13.2%; linerboard, 7.3%; container chip and filler board, 0.3%; and other converting grades, 28.2%. The converting grades include nonpackaging and miscellaneous end uses such as tube, can, drum, tag, file folder, match stem, tablet backs, book cover, and game boards. Not included are various types of construction paper and board such as roofing paper.

U.S. STATISTICS FOR RECYCLED BOXBOARD AND PAPERBOARD[1]

	1991e	1990	1989
Production, 000 tons	8,862	8,731	8,754
Capacity, 000 tons	10,455	10,026	9,617
Utilization rate, %	84.8	87.1	91.0
Imports, 000 tons	85	100	95
Exports, 000 tons	64	52	38
Apparent U.S. consumption			
000 tons	8,883	8,779	8,811
lb/capita	71.00	70.34	71.85
000 tons/billion $ real GNP (1982)	2.11	2.11	2.14

e = Estimate.

1. All tons are short tons.

Sources: American Paper Institute, *Pulp & Paper* estimates.

Overall demand for recycled paperboard grades is growing slowly due to the product maturity of many recycled paperboard markets. In addition, there is competition from kraft paperboard grades and plastic packaging as well as weakness in the manufacturing and construction segments. Production during the last decade grew at an average rate of 1.7%. The fastest growth was in clay-coated folding boxboard grades and containerboard—a trend that is expected to continue. During the same period, uncoated chipboard, setup boxboard, and some miscellaneous uses declined.

The combination of slow growth in many mature markets and rising energy and fiber costs forced a number of recycled mills to close permanently in the 1970s. The industry has also undergone a major period of consolidation during the past two decades, which eliminated some production capacity. More capacity was retired from recycled paperboard than from any other sector of the industry, with over 2.7 million tons, or 34% of recycled paperboard annual capacity, taken out of production in the 1970s. These losses were offset by a number of modernization projects that improved quality and expanded machine capacity, therefore keeping total industry capacity relatively stable.

Between 1977 and 1986, recycled board capacity increased just 176,000 tons, for an average annual growth rate of 0.2%, according to the American Paper Institute. Much of this additional capacity resulted from the startup of Inland Container Corp.'s new 175,000-tpy Ontario, Calif., recycled linerboard mill in 1985.

Despite the removal of 100,000 tons of annual capacity in 1986 due to an idled mill, recycled board capacity rose 457,000 tons between 1985 and 1987, a 5.2% increase. Capacity climbed again in 1988 and 1989, reaching 9.6 million tons in 1989. In 1991, capacity increased to 10.5 million tons following the startup of two newly refurbished machines that will produce tube and core stock.

The projected increase in capacity for recycled paperboard for 1991-93 is more than double the increase during the previous three years. Current producers as well as new entrants into the industry will add 1.4 million tons of capacity to the 1990 base. Containerboard grades will account for 1.1 million tons, or about 78%, of the new capacity.

A good part of this future capacity growth will come from several greenfield mills that will produce recycled linerboard and corrugating medium. In addition, more than 20 separate machine rebuilds and capacity expansions are planned across the U.S. The resurgent demand for certain recycled packaging grades, combined with the increasing need to reduce solid waste, will sustain capacity growth in the next few years.

INDUSTRY STRUCTURE

Several companies, such as Jefferson Smurfit Corp., Newark Group Inc., Sonoco Products Co., Caraustar Industries Inc., and Rock-Tenn Co., have expanded their positions in the industry, while others have sold off or closed their recycled board mills. Jefferson Smurfit, headquartered near St. Louis, Mo., is by far the largest player in the industry, with 1.33 million tons of annual capacity. It purchased 50% ownership of Container Corp. of America in 1986 and subsequently acquired all of CCA in a deal with Morgan Stanley & Co. Jefferson Smurfit's other major acquisitions include Alton Packaging Corp. and several paperboard mills purchased from Diamond International Corp. and Union Camp Corp.

New Jersey-based Newark Group is the second largest manufacturer of recycled paperboard products in the U.S., operating 11 paperboard mills nationwide with total capacity of about 875,000 tpy. Its recent acquisitions include Federal Paper Board Co.'s Los Angeles, Calif., recycled board mill and National Gypsum Co.'s Stockton, Calif., mill.

Sonoco Products is the third largest recycled paperboard producer, with an estimated capacity of 850,000 tpy. In 1987, the company purchased Boise Cascade Corp.'s consumer packaging division, making it the country's largest producer of composite cans, tubes, and cores. In 1988, Sonoco purchased Federal Paper Board's Richmond, Va., cylinderboard mill to supply its own core, tube, and drum manufacturing plants. In 1991, Sonoco purchased a similar type of mill in Montreal, Que., from Canadian producer Paperboard Industries Corp. to supply its Canadian core and tube plants.

Paperboard Industries, Toronto, Ont., acquired Big M Paperboard Inc. in Palmyra, Mich., in 1986 and Belkin Inc. of Vancouver, B.C., in 1987. The enterprise grew again in 1988 with the purchase of Rolph-Clark-Stone Packaging, which included six folding carton plants. In 1991, however, Paperboard Industries sold several recycled board mills as part of a planned divestment program. The company remains the largest producer of recycled paperboard in Canada, with about 490,000 tpy of capacity.

Mead Corp. and Packaging Corp. of America both put their recycled board mills up for sale in 1987. PCA reached a tentative agreement to sell its recycled business to Republic Gypsum Co., but the deal later fell through and PCA decided to keep the mills. In 1990, PCA added to its holdings with the purchase of Jackson Paper Manufacturing Co. Mead successfully completed the sale of its recycled division (consisting of three mills) to Rock-Tenn in 1988.

In 1989, Boise Cascade sold its specialty paperboard division to a private investment group, Specialty Paperboard Inc., but it retained a 30% equity interest in the new company. The transaction included four mills in New York and

RECYCLED COMBINATION PAPERBOARD, BOXBOARD, AND PACKAGING GRADES

- Album board
- Automobile board
- Bending chipboard
- Blister board
- Can stock
- Car lining board
- Chipboard
- Cracker shell board
- Core stock
- Corrugating medium
- Drum stock
- Florist board
- Innersole
- Jute board
- Kraft-backed board
- Laminating board
- Lined board
- Manila board
- Matchbook board
- Mat-finishing board
- Moistureproof board
- Mounting board
- Newsboard
- Offset blanks
- Patent-coated
- Pasteboard
- Photo-mount board
- Poster board
- Pulpboard
- Saturating board
- Shoeboard
- Test chipboard
- Test linerboard
- Transformer board
- Tube stock
- Wallboard
- Water-resistant board
- Waterproof board
- Wet-strength board
- White-lined board

TYPICAL GRADE STRUCTURE FOR TEST LINERBOARD

Basis weight[1] (lb/1,000 ft^2)	Caliper[1] (0.001 in.)	Mullen[1] (psi)
42	12	80-85
47	13	90
48/52	13/15	95/100
69	19	130

1. Tests are approximate. These grades supplied in other weights and at different levels of mullen.

Vermont that produce a variety of chipboard and pressboard grades that are used in the manufacture of book covers, office supplies, graphic arts, and specialty boxboard. In early 1991, the Sheldon Springs, Vt., mill was sold to Rock-Tenn.

One of the largest reductions in U.S. recycled board capacity occurred in 1980 when Whippany Paper Board Co. declared bankruptcy, idling 450,000 tpy. Some of the former Whippany mills have been sold and have reopened under new ownership. Whippany's Clifton, N.J., mill was sold to V. Ponte & Sons, a wastepaper dealer, which formed a new company, Recycled Paperboard Inc., to rebuild the mill's two cylinderboard machines to produce chipboard grades beginning in mid-1990.

The former Morris Paperboard mill in Paterson, N.J., was purchased in 1986 by People's Rep. China's state-controlled National Packaging Corp. The mill was subsequently closed in 1988 and sold to Paper Board Specialties, which reopened the mill in mid-1990.

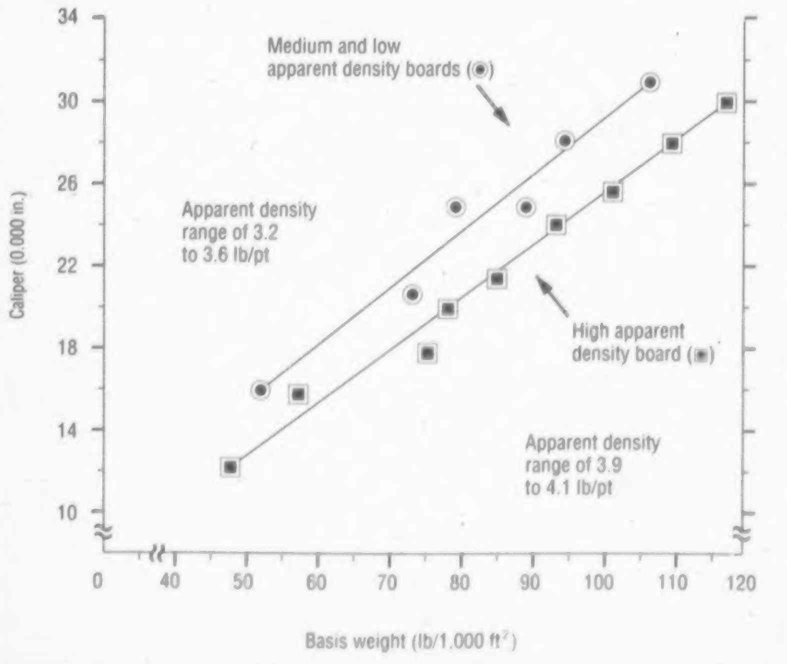
As a result of such activities, industry concentration increased significantly over the past decade. The total market share held by the ten largest U.S. recycled board producers grew from 42% in 1978 to approximately 60% in 1990. The competitiveness of recycled paperboard mills continues to be affected by high energy costs (because these mills rely largely on purchased energy and have no spent pulping liquors or woodwastes to burn) and fluctuations in wastepaper costs. In 1986-87, wastepaper fiber prices skyrocketed, but prices for recycled paper products remained flat, so profits were substantially depressed. Conversely, when wastepaper prices are depressed due to oversupply, recycled mills have a cost advantage over kraft grades because their raw material costs are extremely low. If mills can then increase their prices, their profits will rise. This is the scenario that developed during 1988-89 and has continued through 1991.

RECYCLED FOLDING CARTON

The boxboard packaging grades usually consist of four or more plies of paperboard. The top layer is made from deinked pulp or other high-quality wastepaper, such as one of the pulp substitutes. Middle plies are made with lower-quality paperstock, such as old newspapers (ONP) and mixed papers combined with some old corrugated containers (OCC) for added strength. The fiber content of the bottom layer (or back ply) depends on the strength and appearance preferred on the inside of the carton or box. This ply can be newsback, kraft-back, or white-lined. Most folding carton grades are clay-coated to improve the printing quality and smoothness of the board surface.

TYPICAL GRADE STRUCTURE FOR BOXBOARD GRADES

(approximate relation between caliper and basis weight for high- and low-density boards)

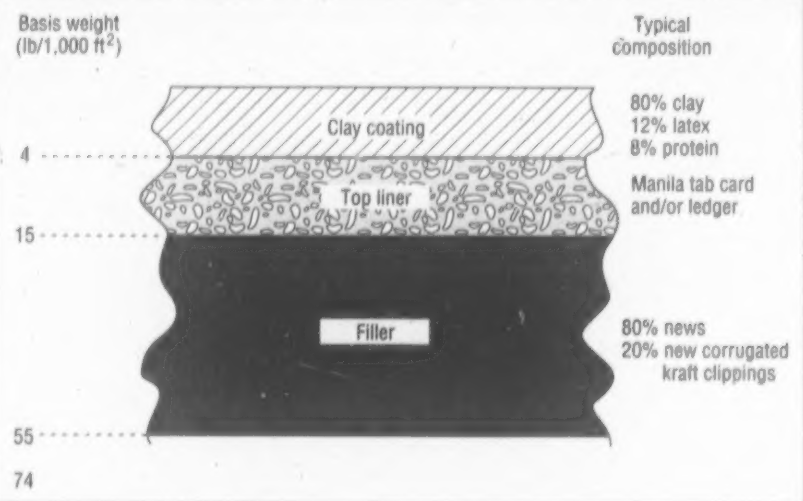


In 1990, clay-coated recycled folding boxboard production was about 1.7 million tons. Other recycled folding boxboard grades, such as uncoated bending chipboard and white-lined grades, accounted for a smaller amount of total recycled folding boxboard—about 670,000 tons in 1990. Production of recycled boxboard for folding cartons has increased about 100,000 tons in the past several years, resulting mostly from machine rebuilds and incremental capacity increases in the industry.

Recycled folding carton grades are produced in calipers ranging from 16 to 20 pt and in basis weights ranging from about 66 to 110 lb/1,000 ft². Sheet density is the basis weight divided by the caliper. A typical clay-coated recycled folding carton grade has a caliper of 16 to 20 pt and basis weight of 66 to 82 lb/1,000 ft².

Recycled folding carton board competes with bleached and unbleached kraft paperboard. API reports that recy-

COMPOSITION OF 18-POINT CLAY-COATED FOLDING BOXBOARD


Basis weight
(lb/1,000 ft²)
Typical composition
Clay coating
80% clay
12% latex
8% protein
4
Top liner
Manila tab card and/or ledger
15
Filler
80% news
20% new corrugated kraft clippings
55
74

U.S. PRODUCTION OF RECYCLED BOXBOARD—FOLDING AND SETUP

(000 short tons)

		Recycled folding boxboard[1]				
Year	Total folding	Unlined chipboard	Kraft lined	White lined	Clay coated	Total setup boxboard[2]
1990	2,424	568	n.a.	n.a.	1,744	295
1989	2,564	562	113	142	1,747	292
1988	2,589	556	137	140	1,756	300
1987	2,561	537	162	130	1,731	240
1986	2,284	441	219	168	1,456	273
1985	2,268	468	203	193	1,404	259
1984	2,310	471	168	224	1,447	307
1983	2,369	585	180	227	1,377	263
1982	2,152	546	146	152	1,308	238
1981	2,425	n.a.	176	189	n.a.	298
1980	2,350	606	81	220	1,443	560
1979	2,386	678	98	229	1,380	604
1978	2,469	706	131	247	1,384	687
1977	2,423	687	133	274	1,330	717
1976	2,508	707	145	313	1,343	747
1975	2,108	564	124	274	1,146	672
1974	2,423	697	137	439	1,149	796
1973	2,652	740	146	520	1,246	998
1972	2,656	793	140	533	1,190	985
1971	2,575	n.a.	n.a.	n.a.	n.a.	979
1970	2,727	n.a.	n.a.	n.a.	n.a.	1,042
1969	2,852	n.a.	n.a.	n.a.	n.a.	1,164

n.a. = Not available.

1. Bureau of the Census defines as combination bending board.
2. Bureau of the Census defines as combination nonbending board. These boards are used to produce rigid paperboxes, among other uses.

Source: Bureau of the Census, American Paper Institute.

cled paperboard has 46.4% of the domestic folding carton market. Bleached paperboard has a 35% share, and unbleached kraft board has an 18.7% share.

It is likely that the current growth rates for folding cartons will be lower than the historical trend because demand is highly dependent on consumer spending, which began weakening in mid-1990. The annual growth rate over the next few years will likely drop to about 1.5% to 2.0%, according to one industry estimate. The recent strength in folding carton markets has been sustained by new products such as videocassettes, compact discs, and other electronic products.

U.S. PRICES FOR RECYCLED BOXBOARD GRADES

($/short ton)

Year	20-pt clay-coated 80 bright (rolls)	20-pt chipboard bending (rolls)
1991		
3Q	$540/580	$365
2Q	540/580	365
1Q	540/580	365
1990		
4Q	540/580	365
3Q	500/545	365
2Q	500/545	365
1Q	500/545	365
1989		
4Q	465/510	340
3Q	465/510	340
2Q	465/510	340
1Q	465/510	340
1988		
4Q	450/475	340
3Q	440/460	340
2Q	410/430	340
1Q	410/430	320
1987		
4Q	380/400	320
3Q	380/400	320
2Q	355/375	320
1Q	355/375	320
Year end		
1986	380/420*	320*
1985	350/400*	300*
1984	370/425*	300*
1983	370/425*	280/300*
1982	380/425*	280*
1981	400/425*	270/280*
1980	380	275
1979	355	260
1978	305	225
1977	284	219
1976	262	212
1975	257	204

*Discounting reported from list prices. Prices on both grades highest on the West Coast and lowest in the Midwest, except for 1987 when prices in the East were lowest.
Source: *Pulp & Paper Week*.

Grade competition. The popularity of bleached paperboard has been undermined by its high price compared with clay-coated recycled and unbleached kraft grades. The price differential between bleached board and clay-coated recycled newsback (CCNB) folding carton board reached an unprecedented level of almost $300/ton in 1989. Prices for 20-pt CCNB reached $465/ton in 1989, vs $780/ton for 15-pt solid bleached sulfate (SBS). In third-quarter 1989, SBS producers pushed prices to $830/ton, and in first-quarter 1990, CCNB prices climbed to $500/ton. In late 1990, CCNB prices increased to about $545/ton, and in 1991, SBS prices increased to $870/ton. Unbleached kraft folding carton board prices currently fall in between, at about $650/ton.

Clay-coated recycled boxboard, which is typically coated on only one side with on-machine coaters, is primarily used to package nonfood products such as soaps and detergents, hardware, toys, and lower-priced cosmetics and toiletries. It is also used with some dry foods, such as cookies, cereal, and biscuits, that are first packaged in a plastic bag or inner liner to eliminate direct food contact with the carton. Waxes, polyethylene, and other special coatings may be applied to the carton surface to give the package special barrier properties. CCNB is readily identifiable by the gray appearance of its unprinted side. Boards that have a kraft backing are identified by their brown, unprinted side.

Quality and productivity have been upgraded at most recycled paperboard mills that produce the folding carton grades. Older cylinderboard machines have been rebuilt and equipped with new headboxes, multi-ply forming sections, and press sections. Innovations such as Kobayashi Engineering's Ultra Former, Black Clawson's pressure formers, and the Inverform process have allowed improved cylinder forming on these machines and enabled recycled board mills to compete more effectively with bleached and unbleached boards. A lower-density sheet can be produced on these advanced formers more effectively than on conventional cylinderboard machines—between 3.9 and 4.2 lb/pt on traditional cylinderboard machines vs 3.4 and 3.8 lb/pt on newer formers.

The industry's older cylinderboard machines that have not been upgraded to produce premium clay-coated folding carton board grades usually produce lower-grade uncoated boards and nonbending chipboard grades. The uncoated bending grades have a folding capability and printing surfaces more appropriate for items such as pizza boxes and paper clip boxes. The nonbending grades are used primarily in the manufacture of setup boxes and other products for which stiffness and rigidity are important, and they are priced by specific use. Prices of nonbending board averaged about $340/ton in 1989 and increased to $365/ton in first-quarter 1990.

RECYCLED SETUP BOXBOARD

Rigid boxes, book binding boards, game boards, and other miscellaneous products are the primary uses for setup boxboard, also called nonbending chipboard. Grades include plain chipboard, news vat-lined chip, filled news, and white vat-lined chip. Generally, plain chip is made from mixed wastepapers; news vat-lined has one side lined with ONP to give it a smooth, clean appearance; filled news is lined on both sides with ONP; and white-lined has a white surface on one side, resulting from the use of higher grades of wastepapers. These grades can be pasted or laminated to form nonbending boards of greater thickness.

Plain setup chipboard is usually overwrapped with specialty grades of decor paper to create an attractive box or book binding. Rigid boxes are commonly used for candy, stationery, jewelry, toiletries, and recently even computer software. Nonbending chipboard is also used in the manufacture of game boards and book bindings.

Setup boxboard is usually made from wastepaper of a lower grade than that used for folding cartons because bending and scoring requirements are not very important for setup boxes. Setup boxboard grades are generally produced in the 20- to 65-pt caliper range. Higher-caliper grades ranging from 60 to 150 pt can be produced by pasting lower-caliper grades together.

The traditional rigid box is much more expensive to produce than a folding carton because it is often custom designed to hold a specific product and its manufacturing is more labor intensive. Therefore, it is typically used to package expensive goods in uniquely designed boxes that reflect the product's high quality.

Production of setup boxboard has decreased from a peak of over 1 million tons annually in the 1950s to about 300,000 tons in 1990. The decline in output came largely from folding carton competition as well as the substitution of thermo-formed plastic packaging. New packaging methods have steadily eroded the setup box market. Also, demand is lower for some products formerly packaged in rigid boxes, for example, men's and women's hats and apparel. Demand has been stable in recent years, and this trend is forecast to continue in the next few years. Declining demand for setup boxes has also caused a significant amount of attrition and consolidation among traditional setup box manufacturers, but the market has stabilized in recent years.

The industry is moving ahead by cutting costs and boosting productivity, diversifying its product mix, and opening new market areas. Converters have improved product design, appearance, graphics, and color printing through the use of better inks and ink-curing processes as well as through new processing and coating techniques that improve strength and moisture resistance of rigid boxes.

Such moves should help setup boxes carve out a bigger niche in the market for special-purpose, higher-value packaging. The Dept. of Commerce (DOC) forecast about a 1.5% annual rise in the real value of setup paperboard box shipments between 1987 and 1991. Cosmetics, pharmaceuticals, confectionery, and electronics are expected to be growth areas for this custom packaging. Competition will persist from other packaging, especially folding cartons and molded plastic containers, but setup board should retain most of its current market share for specialty packaging.

CONTAINERBOARD

Recycled containerboard, i.e., linerboard and corrugating medium, is produced on fourdrinier or cylinderboard machines. Recycled linerboard, also known as test linerboard, and corrugating medium are typically made from a furnish consisting mostly of OCC. Linerboard is manufactured to a specific burst or mullen strength (e.g., 95 to 100 psi to be equivalent to 42-lb linerboard produced from virgin kraft fiber).

A recycled mill usually produces a higher sheet weight in order to make test linerboard equivalent to kraft linerboard. For example, a 100-lb test linerboard might have a basis weight of 48 to 50 lb/1,000 ft^2, compared with 42 lb/1,000 ft^2 for kraft linerboard.

Recycled linerboard production doubled between 1984 and 1988, reaching slightly over 400,000 tons in 1988. But demand dropped sharply in 1989 and through mid-1990 because of weakening linerboard markets. Production has swung back, however, because new capacity is being added. In 1991, Green Bay Packaging Inc. converted a kraft linerboard mill to 100% recycled board production. Stone Container Corp. is also converting a kraft linerboard mill to 100% recycled grades. Production of recycled linerboard is forecast to increase in the U.S., principally due to the rising public demand for recycling and new industry specifica-

CANADIAN PRODUCTION OF BOXBOARD GRADES

(000 metric tons)

Year	Folding	Nonfolding	Other*	Total
1990	467	65	229	761
1989	448	60	247	755
1988	424	61	238	723
1987	435	63	244	742
1986	331	97	298	726
1985	324	94	279	697
1984	329	129	299	757
1983	322	116	268	704
1982	277	104	245	627
1981	300	118	298	716
1980	281	107	292	680
1979	286	108	338	731
1978	247	121	321	689
1977	216	121	280	617
1976	203	73	247	525
1975	174	92	216	482
1974	231	129	288	647
1973	242	96	274	612
1972	248	86	271	605
1971	238	91	240	569
1970	234	93	243	570
1969	239	95	248	582

*Folding includes solid bleached and recycled boxboard. Other includes tube, can, drum, gypsum liner, and mill wrap.

Source: Canadian Pulp & Paper Assn., *Pulp & Paper* estimates.

tions for corrugated box construction. In addition, the low capital cost of installing new recycling capacity makes it an appealing alternative to kraft linerboard mills. Several greenfield recycled containerboard mills are being proposed for startup beginning in 1992.

Recycled corrugating medium is more accepted in the U.S. as a substitute for semichemical medium, and this trend has fueled a sharp increase in capacity. Recycled corrugating medium accounts for about 25% of the 7.0 million tons of corrugating medium consumed in the U.S. annually.

Major producers of recycled medium and linerboard include Inland Container, Jefferson Smurfit, Gaylord Container Corp., Chesapeake Corp., Virginia Fibre Corp., Green Bay Packaging, Menominee Paper Co., and Stone Container. In Canada, Paperboard Industries and Cascades Inc. are the major producers of recycled containerboard. In late 1988, Nolichucky Industries Corp. declared bankruptcy, resulting in the shutdown of about 180,000 tons of recycled containerboard production capacity at three mills. Two foreign firms—Australia's Pratt Group and Japan's Daishowa Paper Manufacturing Co.—have expanded into recycled containerboard production in the U.S.

RECYCLED INDUSTRIAL/CONVERTING PAPERBOARD

Gypsum wallboard. Used as the front and back liner for gypsum construction board, gypsum wallboard is generally made by large, integrated producers of construction papers and board. Major producers include U.S. Gypsum Co., National Gypsum, Georgia-Pacific Corp., Celotex Corp., Republic Gypsum, and Domtar Inc. Recently, National Gypsum and U.S. Gypsum sold recycled paperboard mills that produce gypsum wallboard.

Demand for gypsum wallboard is closely linked to housing construction. As a general rule, about 50% of gypsum wallboard is used in construction of new family housing, 20% in nonresidential buildings, 20% in repair and remodeling, and the remaining 10% in other uses. Because few products offer comparable value at such low prices, the market is expected to stay strong in the long term. In the short term, however, demand may fluctuate significantly because it follows the general construction and housing market and interest rates. During 1984-90, U.S. production fluctuated between 1.1 and 1.3 million tpy. In 1991, production dropped about 25% due to the severe recession in construction.

Tube, can, core, and drum. These products comprise one of the largest markets for recycled paperboard. These end uses consume about 15% of total recycled paperboard production, amounting to an estimated 1.3 million tons in 1990. Approximately 150,000 tpy of unbleached kraft paperboard and a small amount of semichemical paperboard are also used in these products.

The largest market segments for fiber-based tubes, cores, and cones is in textiles, paper, plastic film, and cable. Industrial drums and containers are also a large market. Together, these industrial products account for about 70% of the volume. The remaining 30% of the market is mostly composite cans used in consumer packaging for frozen juices, snacks, and a variety of dry foods.

The industry is highly integrated, with paperboard producers such as Sonoco Products and Jefferson Smurfit operating converting operations at their own mills or nearby. Most mills and converting facilities are located near the industrial markets they serve because of the relatively high shipping costs for bulky cores, drums, and tubes. U.S. Paper Mills Corp., for example, specializes in supplying lightweight core stock to the many tissue and towel converting operations located in Wisconsin. Greif Bros. Corp., which owns no paper mills, is the largest independent con-

U.S. PRODUCTION OF SPECIAL RECYCLED PACKAGING AND INDUSTRIAL CONVERTING PAPERBOARDS

(000 short tons)

Year	Total	Gypsum linerboard	Tube, can, and drum stock	Panelboard wallboard stock	Others
1989	3,099	1,198	1,146	23	732
1988	3,129	1,239	1,151	35	704
1987	3,070	1,227	1,124	48	671
1986	2,950	1,145	1,043	64	698
1985	2,814	1,079	1,021	68	646
1984	2,772	915	1,064	150	643
1983	2,406	798	858	148	602
1982	2,119	750	767	119	635
1981	2,144	809	634	100	601
1980	2,262	1,036	564	113	548
1979	2,543	1,210	628	137	568
1978	2,453	1,185	601	119	546
1977	2,378	1,099	680	113	485
1976	2,205	963	701	86	454
1975	1,913	821	630	67	395
1974	2,228	960	733	67	467
1973	2,403	1,051	763	94	493
1972	2,278	1,053	728	117	380
1971	2,048	936	641	105	366
1970	1,739	807	573	90	270
1969	1,771	847	527	113	285

Source: Bureau of the Census. Annual data no longer available after 1989.

verter of industrial fiber drums in the U.S.

Industry structure underwent a substantial shift during the 1980s. In 1982, Container Corp. of America and Owens-Illinois Inc. left the business. CCA sold its composite can division to Sonoco but retained its plastic drum business. Sonoco later added to that acquisition by buying Continental Fibre Drum's 13 plants early in 1985, and it acquired Plast-Drum Inc. in 1986 to expand into plastic industrial drums. In 1987, Sonoco purchased the consumer packaging division of Boise Cascade, which included 27 composite can and/or plastic bottle plants.

Meanwhile, Jefferson Smurfit acquired CCA's plastic drum business in 1986 and then consolidated it with the industrial fiber drum business it acquired from Alton Packaging. Another major player in the market is Caraustar Industries' affiliate Star Paper Tube Inc., which bought Apache Products Inc. early in 1985, bringing the total number of its tube and core plants to 17. Later in 1985, Clevepak Corp. indicated it would sell its container and core division to an employee group.

While paperboard use in industrial tube, drum, and core products grew about 1.5%/year during the past decade, use of composite cans for packaging declined sharply. Virtually all motor oil packaging has shifted from composite cans to plastic containers, and much of the frozen juice concentrate market has changed to plastic containers as well.

The continuing downward spiral of composite fiber cans is the main reason for low growth in this segment. Competition from plastic cans, flexible plastic pouches, aseptic containers, and paperboard, metal, and glass containers caused sales of composite cans to drop an estimated 7.0% in volume in 1985-86. This compares with a loss of 8.5% during 1984-85, according to DOC. Through 1987, the decline in the value of shipments of fiber cans, drums, and similar products eased slightly, falling only 3%. During 1987-91, the industry is expected to grow at an inflation-adjusted annual rate of 1%. The composite can segment will improve modestly, with increased shipments for such end uses as pet food, snack food, powdered drinks, frozen food, and nonfood containers (see chapter on converted paper and board products).

Basestocks for tube, core, and drum products are produced in a variety of basis weights and compositions. For cores, the principal test is crush resistance. Typically, an outer ply of virgin kraft paperboard in a 13-pt caliper range is used for core stock. The inner layers are made from semichemical furnish, high-yield kraft, or recycled furnish. In most cases, recycled paperboard cores use a 17-pt caliper core stock. In making core or tube stock, parent rolls are cut into rolls about 5 in. wide. Standard cores have a 3-in.

U.S. FOLDING BOXBOARD MARKET SHARE BY GRADE

(000 short tons)

Year	Total	Recycled		Solid bleached sulfate (SBS)		Coated unbleached kraft	
		Ton	Share	Ton	Share	Ton	Share
1990	5,198	2,410	46.4%	1,818	35.0%	970	18.7%
1989	5,370	2,403	44.7	1,980	36.9	987	18.4
1988	5,292	2,352	44.4	2,016	38.1	924	17.5
1987	5,210	2,342	45.0	2,003	38.4	865	16.6
1986	5,056	2,256	44.6	1,911	37.8	889	17.6
1985	4,805	2,241	46.7	1,742	36.2	822	17.1
1984	4,876	2,277	46.7	1,847	37.9	752	15.4
1983	4,646	2,211	47.6	1,725	37.1	710	15.3
1982	4,334	2,076	47.9	1,567	36.2	691	15.9
1981	4,588	2,260	49.3	1,655	36.1	672	14.6
1980	4,490	2,234	49.8	1,575	35.1	680	15.1
1979	4,721	2,309	48.9	1,714	36.3	698	14.8
1978	4,702	2,321	49.4	1,763	37.5	618	13.1
1977	4,547	2,367	52.1	1,592	32.8	588	12.9
1976	4,715	2,340	49.6	1,797	38.1	578	12.3
1975	3,896	1,978	50.8	1,456	37.4	463	11.9
1974	4,427	2,281	51.5	1,676	37.9	470	10.6
1973	4,705	2,522	53.6	1,728	36.7	455	9.7
1972	4,440	2,477	55.8	1,573	35.4	390	8.8
1971	4,139	2,408	58.2	1,392	33.6	340	8.2
1970	4,080	2,473	60.6	1,263	31.0	343	8.4
1969	4,262	2,629	61.7	1,346	31.6	287	6.7
1968	4,218	2,730	64.7	1,227	29.1	261	6.2

Source: American Paper Institute.

dia and varying wall thicknesses, with 3/8-in. and 1/2-in. wall thicknesses being common.

Panelboard. Panelboard is used to manufacture thick, rigid boards used in home construction, automobiles, and trailers. Basestock is produced on cylinderboard machines and then pasted or laminated together to make panels or wallboards of different thicknesses. Wallboard and panelboard stocks are made by a limited number of producers. The long-term market for these grades is static, although demand tends to fluctuate with the levels of trailer production and new construction. About 115,000 tons of recycled paperboard are used annually in these applications.

Other recycled paperboard. This category includes a wide range of specialty board used in display boards, book bindings, game boards, etc. Specialty uses are expected to continue growing, although at a modest rate with limited production. These miscellaneous applications consume approximately 200,000 tons of recycled paperboard annually.

FORMING METHODS

During the last two decades, recycled cylinderboard grades lost much of their competitive advantage to fourdrinier board grades in folding carton packaging. On a fourdrinier paper machine, SBS boards can be produced at higher speeds and with somewhat lower density and machine-direction/cross-direction (MD/CD) stiffness or grain ratio than recycled paperboard grades. This improved board stiffness allows higher line speeds on carton filling machines. The fourdrinier, however, is limited in the caliper ranges that it offers. Bleached boards are usually produced in calipers ranging from 10 to 28 pt, although they rarely exceed 20 pt.

Cylinderboard machines typically produce boards in calipers ranging from 16 to 45 pt, with most cylinder machines able to produce a wide range of combination paperboard, folding and setup boxboard, corrugating medium, gypsum linerboard, and chipboard. The typical cylinder machine with an open stock-flow system and conventional cylinder mold and vat forming system is limited in its performance. Because of the limitations of depending on centrifugal forces, it is difficult to operate a conventional cylinderboard machine at speeds over 600 fpm. The paperboard grades formed in this method will have a tensile ratio of 4:1 (MD/CD) and no better than 3:1.

In a conventional cylinder-forming system, the cylinder mold rotates opposite to the stock flow (counterflow vat). Stock is formed on a wire-covered cylinder mold by pressure differential inside and outside the cylinder mold. The sheet, or ply, is couched off the top of the cylinder by a felt and ply. Counterflow systems produce a sheet with a high MD fiber orientation. As speed increases, sheet formation becomes poorer; with significant variations in the sheet, weight pickup decreases.

Sheet formation can be improved somewhat by using a direct vat where cylinder mold rotation is in the same direction as stock flow. Any additional improvement in formation can be achieved by using a dry vat. Conventional cylinder formers can be upgraded in several ways. The easiest, least expensive method is to add new slice or headbox designs (pressure formers) to existing cylinder machines. This results in better control over grain ratios and improved dewatering. However, such units have limited speed and rarely exceed 600 fpm. Units such as the Beloit's Stevens Former and Sandy Hill's Rotoformer use vacuum suction to

U.S. AND CANADIAN CAPACITY FOR RECYCLED PAPERBOARD

(000 short tons)

	U.S. annual capacity					Canadian annual capacity
		Recycled paperboard grades				
Year	U.S. total	Paperboard[1]	Folding and setup	Gypsum liner	Other[2]	Recycled boxboard
1991e	10,455	3,087	3,002	1,383	2,983	825
1990e	10,029	2,791	2,939	1,405	2,894	816
1989	9,612	2,531	2,859	1,405	2,816	815
1988	9,532	2,476	2,889	1,411	2,756	779
1987	9,268	2,240	2,936	1,386	2,706	782
1986	9,008	2,089	2,934	1,349	2,637	772
1985	8,795	1,998	2,929	1,265	2,603	785
1984	8,722	2,145	2,922	1,249	2,405	783
1983	8,692	2,068	2,995	1,217	2,412	745
1982	8,690	2,130	3,007	1,255	2,298	730
1981	8,600	2,121	2,968	1,251	2,260	770
1980	8,617	2,122	2,942	1,238	2,313	783
1979	8,757	2,111	3,019	1,273	2,355	761
1978	8,642	2,015	2,986	1,238	2,403	751
1977	8,699	2,132	3,117	1,112	2,337	696
1976	8,774	2,235	3,155	1,046	2,337	647
1975	8,717	2,221	3,123	1,063	2,310	644
1974	8,680	2,132	3,170	1,100	2,278	614
1973	8,330	1,833	3,182	1,093	2,221	581
1972	8,185	1,785	3,109	1,082	2,209	559
1971	8,078	1,652	3,292	1,031	2,104	—
1970	8,084	1,697	3,381	1,013	1,993	—

e = Estimate.

1. Includes linerboard, corrugating medium, and container chip and filler board.

2. Others include tube, can, and drum stock, special packaging boards, and panel and wallboard stocks.

Sources: American Paper Institute, Canadian Pulp & Paper Assn.

increase dewatering.

In the late 1960s, Kobayashi Engineering Works of Japan introduced its first former, which it called the Ultra Former. This series became known as cylinder-on-top formers, wherein the sheet is formed and dewatered on top of a cylinder mold or drilled shell and then travels downward from the slice to be transferred to the top of a carrier felt.

The Kobayashi former was designed to replace individual vats on cylinder machines. The Ultra Former permits the felt pickup to wrap the cylinder mold, thus eliminating drop-off, a problem common to conventional cylinder vat machines. The Ultra Former also produces a somewhat lower-density sheet than is possible with conventional cylinder machines.

Another new former, the on-top cylinder former with dewatering wires, is designed to be used with fourdrinier formers, but it can sometimes be used in place of a conventional cylinder vat.

Multi-ply boards can also be produced on modified fourdrinier machines in two ways: small fourdriniers are positioned on top of a long fourdrinier section or on-top formers are positioned on top of a fourdrinier section. Beloit has a different approach for making lightweight multi-ply on a fourdrinier. It uses a headbox (Strata-Flo/Converflo) that can simultaneously deliver a two- or three-ply sheet to either a fourdrinier wire or a twin-wire former.

Twin-wire formers made an early debut into multi-ply forming, but they were used only on a limited basis until the 1970s. The first twin-wire former was jointly developed by St. Anne's Board Mill Co. in the U.K. and Walmsley (Beloit). Called the Inverform, it became the forerunner of all twin-wire formers. Inverform units were placed over a conventional fourdrinier table, and considerable dewatering was achieved through the top wire via drainage in an upward direction.

By the 1970s, several machine manufacturers had developed their own versions of twin-wire formers. Based on its experience with the Inverform, Beloit developed its Bel Bond former, which has better dewatering and speed characteristics and, like the Inverform, can be positioned over a fourdrinier wire to form a multi-ply board.

Kobayashi's Ultra Former, introduced in 1975, combines flat forming and centrifugal water removal with a second fabric wire, but the sheet is formed before the twin forming fabrics meet. The sheet is transferred to a felt, where it is plied to the preceding layer carried by the felt.

In 1988, Black Clawson introduced its Bristol Former MK II pressure former and projection slice headbox, an improved design developed in collaboration with BRDA/St. Anne's Board Mill. The Bristol Former can be fitted to existing equipment and can be installed with a suction roll or as a top-wire former to produce a wide range of multi-ply paperboard grades.

ANNUAL U.S. CAPACITY FOR RECYCLED FOLDING AND SETUP BOXBOARDS

(000 short tons)

Year	Folding	Setup
1993e	2,822	316
1992e	2,712	316
1991e	2,687	315
1990e	2,628	314
1989	2,569	313
1988	2,601	288
1987	2,661	275
1986	2,662	272
1985	2,640	289
1984	2,626	296
1983	2,681	362
1982	2,676	352
1981	2,638	321
1980	2,593	349
1978	2,568	418
1976	2,705	450
1974	2,665	505
1972	2,607	502
1970	2,805	576
1969	3,029	577

e = Estimate.
Source: American Paper Institute.

U.S. EXPORTS AND IMPORTS OF RECYCLED PAPERBOARD[1]

(000 short tons)

Year	Exports	Imports
1990	227	114
1989	185	85
1988	283	86
1987	329	81
1986	199	78
1985	246	68
1984	169	69
1983	150	50
1982	158	31
1981	174	40
1980	249	57
1979	176	42
1978	203	47
1977	268	28
1976	306	13
1975	262	8
1974	283	34
1973	207	33
1972	163	8
1971	168	17
1970	151	10
1969	143	11

1. Bureau of the Census data for total recycled-furnish paperboard, including test containerboard and other paperboard.

ESTIMATED CAPACITIES FOR RECYCLED BOXBOARD/ PAPERBOARD OF MAJOR U.S. COMPANIES

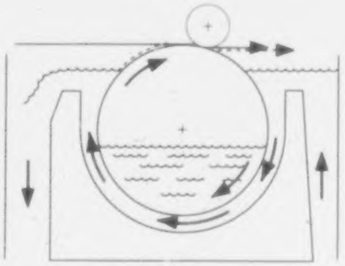
	Company	Annual capacity (000 short tons)	Grades*
1.	Jefferson Smurfit[1]	1,330	CB, BB, CM, LB, CS, TS, SP
2.	Newark Group[2]	875	CB, BB, CM, PB, TS, SP, GL
3.	Sonoco Products[3]	850	PB, CS, DS, TS, SP
4.	Rock-Tenn[4]	607	CB, BB, GL, CS, SP, PB, TS
5.	Caraustar Industries[5]	550	BB, GL, PB, CS, TS, SP
6.	Inland Container[6]	550	CM, LB
7.	Waldorf[7]	395	BB, CS, DS, TS, CB, CM
8.	U.S. Gypsum	390	GL
9.	Packaging Corp. of America[8]	280	CB, BB, PB, CM, LB, GL
10.	Georgia-Pacific	235	GL
11.	National Gypsum	215	GL, PB, CB, BB, CS, TS, SP
12.	Federal Paper Board[9]	175	CB
13.	James River	175	CB, BB, CM, LB
14.	Simkins Industries[10]	160	CB, BB, SP
15.	Republic Gypsum	135	BB, CS, GL, SP, TS, CM
16.	Stone Container	135	CM

*Code: BB-uncoated boxboard; CB-coated boxboard; CM-corrugating medium; CS-core stock; DS-drum stock; GL-gypsum liner; LB-linerboard; PB-unspecified paperboards; SP-specialty paperboards; TS-tube stock.

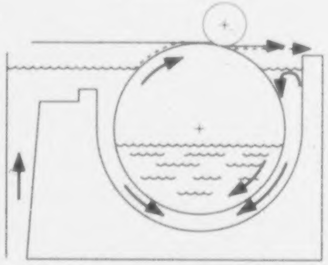
1. Reflects combined operations with Container Corp. of America.
2. Bought Lawrence Packaging Corp.'s Lawrence, Mass., mill in 1985; Federal Paper Board Co. Inc.'s Los Angeles, Calif., mill in 1988; and National Gypsum's Stockton, Calif., mill in 1989.
3. Bought Federal Paper Board Co. Inc.'s Richmond, Va., mill in 1988.
4. Acquired Sheldon Springs, Vt., mill in 1991. Bought Mead Corp.'s mills at Lynchburg, Va.; Cincinnati, Ohio; and Otsego, Mich., in 1987.
5. Bought CCA's mills at Chattanooga, Tenn.; Cincinnati, Ohio; and Chicago, Ill., in 1984. Bought U.S. Gypsum's Camden, N.J., mill in 1988.
6. Subsidiary of Temple-Inland Inc. Started up new 175,000-tpy test linerboard mill in Ontario, Calif., in late 1985.
7. Company formed to buy former St. Regis Corp. boxboard mills at St. Paul, Minn., and Battle Creek, Mich., from Champion International Corp. in 1985.
8. In 1983, sold two chipboard mills to Republic Gypsum Corp. and a clay-coated mill in Stroudsburg, Pa. (later sold to Rock-Tenn Co.). Acquired Jackson Paper Manufacturing Co. in 1990.
9. Sold Richmond, Va., and Los Angeles, Calif., mills in 1988.
10. Bought Lowe Paper Co. in 1984.

COUNTERFLOW VAT VS DIRECT-FLOW VAT

Direct-flow vat



Counterflow vat



Source: Pulp & Paper, December 1978.

ESTIMATED CAPACITIES FOR RECYCLED BOXBOARD/ PAPERBOARD OF CANADIAN COMPANIES

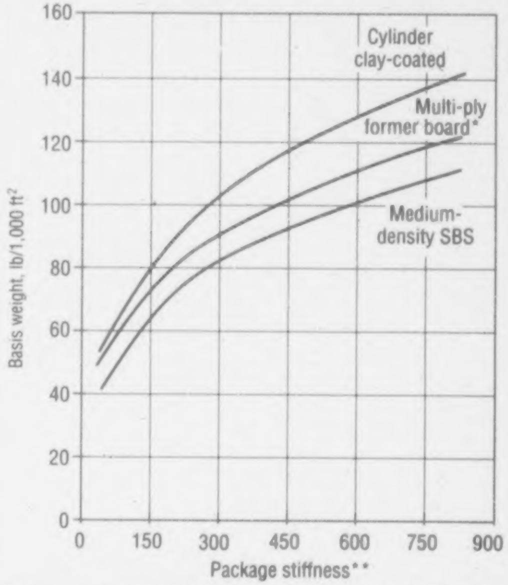
Company	Annual capacity (000 short tons)	Grades*
Paperboard Industries[1]	490	CB, PB, CM, LB, GL
Atlantic Packaging	140	CM, LB
Beaver Wood Fibre[2]	122	BB, PB, TS, GL
Kruger	103	LB, CS, TS
Domtar	90	LB, CM
Sonoco Products	77	PB, CS, TS
Strathcona Paper	61	BB, PB, SB, CB
Minas Basin Pulp & Paper	35	BB, PB, CS, LB, TS, PB
Others	135	

*Code: BB—uncoated boxboard; CB—coated boxboard; CM—corrugating medium; CS—core stock; DS—drum stock; GL—gypsum liner; LB-linerboard; PB—unspecified paperboard; SP—specialty paperboard; TS—tube stock.

1. Sold two mills in 1991.
2. Subsidiary of Georgia-Pacific Corp.

COMPARISON OF PACKAGE STIFFNESS FOR GIVEN FIBER WEIGHT

(SBS board produced on fourdrinier machines, recycled fiber board made on conventional cylinder and on multi-ply formers)



*Assumes basic board density at 3.5 lb/point/1,000 ft^2 coating weight at 8 lb/1,000 ft^2.
**Package stiffness = (MD stiffness)$^{0.33}$ x (CMD stiffness)$^{0.667}$
Source: Fibreboard Corp. and Arthur D. Little Inc.

Source: Pulp & Paper, December 1978.

Fiber:

PULPING PROCESSES

Papermakers have a range of fibers and pulping processes to choose from to achieve particular strength properties in their paper and board products and to ensure good runability on paper machines. Most of the fiber used for papermaking comes from pulpwood, wastepaper, nonwood fibers, and inorganic fibers. In the U.S., less than 1% of the fiber supplied for paper and board production is from nonwood and inorganic sources, such as asbestos or bagasse. Pulpwood provides about 73% of the fiber supply and wastepaper accounts for about 26%.

These raw materials are pulped to separate the fibers from the wood (in the case of pulpwood) or to recover fiber from recycled paper (in the case of wastepaper). Pulping can be accomplished through a number of different mechanical or chemical means intended to release the fibers while maintaining fiber length and strength. The pulping (or cooking) process selected depends principally on the grade of pulp needed to give the strength requirements for a particular paper or board grade. Mechanical pulping uses mechanical energy from grinding or attrition to separate the fibers. Chemical techniques use strong chemicals and high temperatures to dissolve the lignin that binds woodfibers together; then a minimum of mechanical action, referred to as refining, suffices to separate the fibers.

PULPWOOD SUPPLY

The grade of paper or board produced by a mill and its proximity to pulp or pulpwood supplies determine the choice of woodfiber. Southern pine, mixed hardwood, and oak are popular in the U.S. South. In the Pacific Northwest, Douglas fir, hemlock, western pine, and some western cedar, redwood, and spruce are typically used. In the U.S. Midwest, mixed hardwoods, oak, and spruce predominate. In the northeastern U.S. and Canadian regions, eastern spruce, pine, balsam fir, and mixed hardwood are the principal species.

Use of hardwood for pulp production has risen over the years and is expected to rise further as softwood supplies come under increasing pressure. Hardwood makes up about 40% of the U.S. commercial timber supply and about 20% of the total timber volume in Canada. In the U.S., hardwood accounted for just 10% of the fiber supplied for pulpmaking in the mid-1940s, but that figure has since grown to about 30%. Until recently, Canada concentrated on softwood as well, with hardwood use down around 10% for pulp production. To some extent this low number is a result of the nation's focus on the production of bleached softwood kraft pulp and newsprint. But as printing/writing paper capacity rises and hardwood pulp projects proliferate and as softwood felling bumps up against harvesting limits, Canada too will begin relying more heavily on hardwood.

Geography also plays a role in the form in which pulpwood is delivered to the mill—either as chips or logs. In the U.S. Pacific Northwest, 65% to 70% of the pulpwood is sawmill residue remaining from lumber or plywood production. Southern producers until recently relied on sawmill residue for about 30% of their fiber supply, but that figure could increase to 50% within the next decade as timber supplies outstrip lumber and plywood demand. The Northeast is following the trend toward chips but for now relies principally on roundwood.

PULPING AND BLEACHING

Five major pulping processes are used in North America (with numerous subcategories): 1) sulfate (kraft), 2) sulfite, 3) semichemical, 4) mechanical, and 5) defibrated. Chemical pulps are of high strength but are low in yield, down around 45% to 55%. Semichemical pulps, which are made primarily from hardwood, are of somewhat lower quality but show better yield, up around 60% to 80%. The mechanical and defibrated pulps are low in strength but provide high yields.

Once the woodfibers are separated, woodpulp is often bleached to improve brightness. Brightness is measured optically by test instruments that indicate brightness points (GE, ISO, or Elrepho units—used, respectively, in the U.S., Canada, and the rest of the world). Fully bleached chemical pulps have brightnesses in the 85 to 90 GE range, while semibleached pulps average 70 to 80 GE.

Brightening can be carried out by removing residual lignin (delignification) or decolorizing it. Typical chemicals for this stage include the oxidants chlorine (C), sodium hypochlorite (H), chlorine dioxide (D), and hydrogen peroxide (P) and the reductant sodium hydrosulfite. Alkali, usually sodium hydroxide or caustic soda (E), is used to extract solubilized lignin from the cellulose.

Chemical pulp is bleached in large, multistage bleaching processes by sequential chemical and washing treatment. The bleaching sequence chosen depends on pulp type, chemical costs, capital costs, and environmental considerations. For kraft pulp, a typical bleaching sequence might be chlorine, caustic (alkali extraction), chlorine dioxide, caustic (alkali extraction), and chlorine dioxide (commonly represented as the CEDED process). Chlorine for many years was the major chemical used in the first stage of the bleaching process because of its low cost and effectiveness. But the use of chlorine dioxide as a substitute has gained in popularity as producers try to reduce production of dioxins and other chlorinated organic pollutants during the bleaching process. Other common bleaching stages are peroxide (P) or hypochlorite (H). Ozone is being tested as a chlorine alternative in the first bleaching stage, although steps must be taken to protect the cellulose fibers from this harsher bleach.

Additional chemicals may be added during each stage to make the bleach plant more efficient. For example, oxidative extraction is becoming more common. Oxygen and/or hydrogen peroxide is mixed with pulp in the first extraction stage to reduce the amount of bleaching chemicals used farther downstream in the bleach line.

Sulfite pulp producers are turning increasingly to bleaching with oxygen and peroxide or ozone as a substitute for chlorine as they too try to make their pulp more environmentally friendly.

Groundwood and deinked pulps are generally brightened via reductive bleaching, although oxidizing agents, such as

U.S. WOODPULP PRODUCTION

(000 metric tons)

Year	Total all grades	Special alpha/ dissolving	Bleached sulfite	Un-bleached sulfite	Bleached and semibleached sulfate and soda* Softwood	Hardwood	Un-bleached sulfate	Semi-chemical	Ground-wood and thermo-mechanical
1990	57,217	1,173	1,264	152	13,179	11,825	20,024	3,828	5,772
1989	56,244	1,293	1,245	173	12,428	12,020	19,658	3,958	5,469
1988	55,485	1,240	1,238	175	12,110	11,752	19,624	3,952	5,391
1987	54,024	1,190	1,151	155	11,807	11,246	19,451	3,852	5,173
1986	51,725	1,141	1,157	149	11,349	10,567	18,448	3,802	4,978
1985	49,121	1,065	1,238	178	11,001	9,525	17,700	3,653	4,763
1984	50,323	1,094	1,233	235	10,934	9,342	18,798	3,691	4,995
1983	47,586	1,144	1,186	281	10,377	8,772	17,772	3,458	4,597
1982	44,755	991	1,127	313	10,189	7,702	16,484	3,356	4,594
1981	47,212	1,227	1,273	362	10,552	7,656	17,757	3,560	4,826
1980	46,027	1,369	1,324	349	9,867	7,369	17,773	3,652	4,324
1979	44,781	1,360	1,250	358	9,359	7,024	17,762	3,681	3,985
1978	43,032	1,277	1,286	298	9,022	6,494	17,247	3,657	3,750
1977	42,319	1,329	1,499	353	9,016	5,909	16,697	3,516	3,999
1976	41,187	1,348	1,587	380	8,476	5,833	16,171	3,478	3,911
1975	36,838	1,241	1,505	332	6,457	5,114	13,814	3,102	4,003
1974	40,676	1,607	1,736	354	6,960	5,812	15,407	3,437	4,074
1973	41,084	1,517	1,742	338	6,646	5,479	15,955	3,531	4,393
1972	39,544	1,521	1,629	302	6,247	5,103	15,668	3,443	4,180
1971	37,211	1,528	1,503	334	5,915	4,616	14,373	3,256	4,279
1970	37,050	1,557	1,733	361	5,683	4,803	14,206	3,091	4,066
1965	28,855	1,348	2,077	454	3,961	2,822	10,695	2,606	3,540
1960	21,755	1,032	1,855	483	3,754	1,191	7,878	1,807	2,959
1955	17,570	892	1,732	586	2,659	646	6,962	1,264	2,450
1950	12,447	434	1,478	672	2,100		5,179	611	1,973

*Bureau of the Census data show that semibleached sulfate production declined from 1.729 million metric tons in 1970 to 1.078 million tons in 1980—the last year production was broken out; soda pulp production was last shown by Census at 181,000 tons in 1974.

Source: American Paper Institute.

peroxides, chlorine, and hypochlorites, are also used. These brighten pulps to only 55 to 65 GE, often in just one stage of bleaching. Some producers use multistage bleach lines to achieve higher brightness--in the 80 to 82 GE range for new bleached chemi-thermomechanical softwood pulp mills using peroxide bleaching.

The production of pulp bleached without any chlorine compounds whatsoever is gaining momentum as producers and environmentally conscious consumers try to cut back on pulp mill pollution, including dioxins. As noted, the pulp industry has reduced these pollutants by limiting its use of chlorine (in part by switching to chlorine dioxide), and it avoids other dioxin precursors as well. Some environmentalists want the industry to go further, ending the use of molecular chlorine and chlorine-based compounds completely.

The bulk of the world's paper production is printing and writing papers, which have traditionally been made from conventionally bleached sulfate pulp. While the concept of using a more environmentally friendly pulp is appealing, there are a number of drawbacks to incorporating such a product in printing/writing grades. The Canadian Pulp & Paper Assn. says that producers are not, at the moment, able to obtain the qualities desired in terms of strength, purity, and brightness without using some chlorine during pulp bleaching.

Nevertheless, some printing/writing papermakers and their customers have chosen to content themselves with the properties of chlorine-free kraft (sulfate) pulp—as well as alternatives such as bleached sulfite pulp and bleached chemi-thermomechanical pulp (BCTMP). A fair number of sulfite and BCTMP producers exist, but only a handful of pulp suppliers are capable of making chlorine-free kraft pulp. They include Munksjö AB, Södra Skogsägarna AB, and Empresa Nacional de Celulosas AS, all of whom employ oxygen and hydrogen peroxide. Finland's Metsä-Botnia AB makes bleached softwood sulfate pulp using enzymatic bleaching and multistage oxygen treatment.

SULFATE OR KRAFT PROCESS

Two-thirds of North American pulp capacity is based on the sulfate or kraft pulping process—up from 38% back in 1950. The region has about 170 kraft mills, with capacity in the U.S. of 46.1 million metric tons and in Canada of 11.9 million tons, for a total of 57.9 million tons in 1990.

In this alkaline process, woodchips are cooked under high pressures and temperatures in a white liquor solution of sodium hydroxide and sodium sulfide. The chips are pulped in large pressure digesters by either batch or continuous processes for one to two hours at temperatures exceeding 170°C (338°F). The amount of alkali, length of cooking time, and degree of temperature are varied to produce pulps of high or low yield, depending on the quality of pulp desired. The higher-yield pulps have a higher lignin content and are typically used for linerboard and the coarser grades of kraft papers. If a pulp is to be bleached, the kraft pulping stage employs stronger conditions to reduce the pulp's lignin content. Because softwood pulps have more lignin than hardwood pulps, additional chemical is required to cook the pulp to a particular lignin content.

Most wood species can be used in the kraft process, which produces a strong, easily bleached fiber. Chemicals can be economically retrieved in a straightforward process, and waste known as black liquor can be washed from the pulp, concentrated, and burned to recover both energy and chemicals. On the other hand, it is expensive to build a kraft pulp mill—capital requirements can top $500,000/annual ton. And pulp yields are low, down around 45% to 55%. The process is corrosive and requires special metals in the equipment. And finally, producers have run into safety hazards and environmental problems. These include odor, mainly from sulfur compounds, and dioxins and other chlorinated organics produced during chlorine bleaching of pulp. In addition to the new bleaching methods mentioned previously that limit the amount of chlorine required to treat kraft pulp—and thereby cut the amount of chlorinated

U.S. PULPWOOD CONSUMPTION BY PULPING PROCESS

(000 cords or 128 ft^3)

	1989	1988	1987	1986	1985	1984	1983	1980	1970
All processes, total	96,067	95,264	92,386	90,554	84,840	86,948	83,493	79,703	67,562
Dissolving/special alpha	n.a.	3,492	3,014	2,866	2,551	2,544	2,776	3,378	3,673
Sulfite	3,124	3,174	2,915	n.a.	n.a.	n.a.	n.a.	3,494	5,016
Sulfate, total	78,130	77,163	75,085	72,175	66,536	68,611	65,322	62,408	49,366
Bleached and semibleached	42,015	41,247	39,600	36,671	33,340	33,968	32,427	30,110	22,327
Unbleached	36,115	36,108	35,485	35,503	33,832	34,643	32,895	32,299	27,039
Groundwood[1]	n.a.	5,880	5,624	5,513	5,337	5,508	5,142	4,483	4,234
Semichemical	3,999	4,107	4,061	4,081	3,851	3,912	3,798	3,853	3,456
Defibrated or exploded	1,568	1,520	1,687	n.a.	n.a.	n.a.	n.a.	2,087	1,818

n.a. = Not available.

[1] Includes chemigroundwood.

Source: Bureau of the Census.

TABULATION OF NORTH AMERICAN PULP AND PAPER MILLS

	Companies[1]	Establishments[2]	Paper mills[3]	Total pulp mills	Groundwood	Other mechanical[4]	Semichemical	Sulfite	Kraft	Miscellaneous[5]
Alabama	21	23	19	23	4	1	2	—	14	2
Alaska	2	2	—	2	—	—	—	2	—	—
Arizona	2	2	2	5	2	—	—	—	1	2
Arkansas	8	10	9	9	1	1	—	—	7	—
California	33	42	33	12	—	3	—	—	4	5
Colorado	2	2	1	—	—	—	—	—	—	—
Connecticut	19	19	10	1	—	—	—	—	—	1
Delaware	2	4	3	1	—	—	—	—	—	1
Florida	13	13	10	10	—	—	—	1	8	1
Georgia	30	33	22	19	2	1	1	—	12	3
Idaho	2	3	2	1	—	—	—	—	1	—
Illinois	17	18	11	2	—	—	—	—	—	2
Indiana	12	15	13	2	—	—	1	—	—	1
Iowa	2	2	2	1	—	—	1	—	—	—
Kansas	2	2	2	—	—	—	—	—	—	—
Kentucky	4	6	5	3	—	—	1	—	2	—
Louisiana	11	13	13	19	3	1	4	—	10	1
Maine	18	24	20	21	11	—	—	1	7	2
Maryland	4	4	4	1	—	—	—	—	1	—
Massachusetts	31	46	36	5	—	—	—	—	—	5
Michigan	35	41	35	11	2	1	3	—	3	2
Minnesota	12	14	12	9	4	3	—	—	2	—
Mississippi	13	15	12	11	2	2	—	—	6	1
Missouri	7	7	5	1	—	1	—	—	—	—
Montana	1	1	1	1	—	—	—	—	1	—
New Hampshire	17	19	13	2	—	—	1	—	1	—
New Jersey	24	31	17	3	—	—	—	—	—	3
New Mexico	1	1	1	—	—	—	—	—	—	—
New York	52	66	53	13	3	3	—	1	1	5
North Carolina	18	20	16	13	1	3	1	—	5	3
Ohio	32	38	30	10	—	3	2	—	1	4
Oklahoma	7	8	8	6	—	1	1	—	1	3
Oregon	15	23	17	21	6	3	3	—	7	2
Pennsylvania	43	49	35	8	—	1	2	1	3	1
Puerto Rico	1	1	1	—	—	—	—	—	—	—
South Carolina	13	13	12	12	3	1	2	—	6	—
Tennessee	16	19	13	10	2	1	1	—	2	4
Texas	16	18	13	10	3	1	—	—	6	—
Vermont	6	7	6	2	1	—	—	—	—	1
Virginia	18	20	14	10	2	1	3	—	4	—
Washington	19	28	19	24	6	1	3	6	7	1
West Virginia	2	2	2	—	—	—	—	—	—	—
Wisconsin	43	58	47	33	7	4	2	6	4	10
TOTAL U.S.	**362**	**782**	**599**	**347**	**65**	**37**	**34**	**18**	**127**	**66**
Alberta	8	10	4	7	3	1	—	—	3	—
British Columbia	23	38	13	33	13	1	—	1	18	—
Manitoba	5	5	4	5	2	1	—	1	1	—
New Brunswick	10	12	7	13	5	1	2	2	3	—
Newfoundland	2	3	3	5	3	—	—	2	—	—
Nova Scotia	5	5	4	6	3	—	—	2	1	—
Ontario	23	50	35	34	13	3	2	4	9	3
Quebec	45	80	55	69	35	7	2	9	10	6
Saskatchewan	2	2	2	1	—	—	—	—	1	—
TOTAL CANADA	**103**	**205**	**127**	**173**	**77**	**14**	**6**	**21**	**46**	**9**

1. Subsidiaries and autonomous divisions of parent companies are counted as separate units. Totals of this column reflect elimination of duplication of names in more than one state or province.
2. Includes headquarters units.
3. Includes mills manufacturing paper and/or paperboard, regardless of the number of paper machines, and regardless of whether or not one or more pulp mills are located at the site.
4. Includes steam and hot water defibrated, exploded, shredded, cold soda, and chemimechanical woodpulp mills.
5. Includes deinking, rag, soda, rope, flax, bagasse, and cotton linters pulp mills.

Source: *1991 Lockwood-Post's Directory.*

waste products generated, the chlorine charge can also be reduced by cutting down the amount of lignin prior to the bleaching step. This delignification can be carried out with techniques such as the Kamyr process of modified continuous cooking in continuous digesters, Beloit's rapid displacement heating in batch digesters, extended delignification, and various types of oxygen delignification.

Oxygen delignification was developed in the late 1960s and early 1970s, initially as a high-consistency technique, although new systems tend to be medium consistency because of lower capital costs and better efficiency. The process is used after brownstock washing but before bleaching, and it cuts down on chlorinated organics, biological oxygen demand, and color released in effluent from the bleach plant.

Scandinavia and Europe run about half of the 50 or so oxygen delignification systems in existence, North America claims about ten, and at least a dozen more are expected. Unfortunately, oxygen delignification puts an added burden on the chemical recovery system, and this extra 5% load may be untenable for an existing mill that has already fully committed its recovery system. Rather than installing additional boilers and evaporators to handle the extra load, the plant operator might choose other ways to cut chlorine use. One option to limit the amount of dissolved organic solids going to the bleach plant is better brownstock washing.

Other chemical pulping techniques include the soda process and the prehydrolyzed sulfate process. The soda process has a soda cook and uses either sodium hydroxide or soda ash to produce a medium-quality chemical pulp from hardwood species. The prehydrolyzed sulfate process produces a dissolving pulp (chemical cellulose) from hardwood or softwood and is used to produce rayon, acetate, cellophane, or cellulose derivatives.

SULFITE PROCESS

While sulfate pulping has grown in popularity over the years—with North American capacity more than quadrupling over the last 40 years—the acid sulfite sector has lan-

U.S. WOODPULP CAPACITY TRENDS

(000 short tons)

Year	Total all grades	Dissolving and special alpha	Total sulfite[1]	Bleached* softwood sulfate[2]	Bleached* hardwood sulfate[2]	Unbleached sulfate	Semi-chemical[3]	Mechanical	Screenings
1993e	69,193	1,527	1,638	15,805	15,215	23,366	4,706	6,931	5
1992e	69,113	1,527	1,685	15,497	15,016	23,681	4,713	6,989	5
1991e	67,440	1,527	1,671	14,882	14,244	23,454	4,714	6,944	5
1990	65,504	1,524	1,658	14,376	13,497	22,888	4,688	6,869	4
1989	64,289	1,465	1,644	14,196	13,125	22,465	4,753	6,636	4
1988	62,950	1,450	1,627	14,056	12,450	22,145	4,787	6,432	4
1987	61,172	1,389	1,646	13,623	11,823	21,733	4,697	2,942	6
1986	59,750	1,399	1,703	13,169	11,402	21,381	4,631	6,058	7
1985	58,641	1,454	1,738	12,874	10,750	21,182	4,650	5,964	29
1984	59,001	1,487	1,750	12,490	9,867	21,372	4,652	6,122	29
1983	57,590	1,525	1,788	12,111	9,179	21,206	4,490	5,814	31
1982	57,638	1,606	1,780	12,052	8,705	21,435	4,734	5,780	34
1981	56,831	1,598	1,855	11,757	8,559	20,972	4,597	7,434	58
1980	55,214	1,590	1,909	11,339	8,356	20,288	4,601	7,069	61
1979	53,636	1,551	2,004	10,897	8,078	19,923	4,553	6,572	63
1978	52,714	1,573	2,095	10,442	7,729	19,732	4,572	6,507	65
1977	51,849	1,648	2,525	10,048	7,322	19,552	4,514	6,442	71
1976	50,547	1,571	2,417	9,355	7,227	19,293	4,402	6,204	78
1975	49,502	1,671	2,420	9,025	7,208	18,758	4,246	6,090	84
1974	48,995	1,824	2,401	8,923	7,138	18,451	4,233	5,930	97
1973	48,459	1,754	2,378	8,842	6,936	18,475	4,171	5,802	100
1972	46,760	1,756	2,353	8,971	6,093	17,702	3,937	5,813	137
1971	45,731	1,772	2,414	8,266	6,008	17,091	3,814	4,680	156
1970	44,725	1,736	2,490	7,798	5,781	16,811	3,811	4,799	154

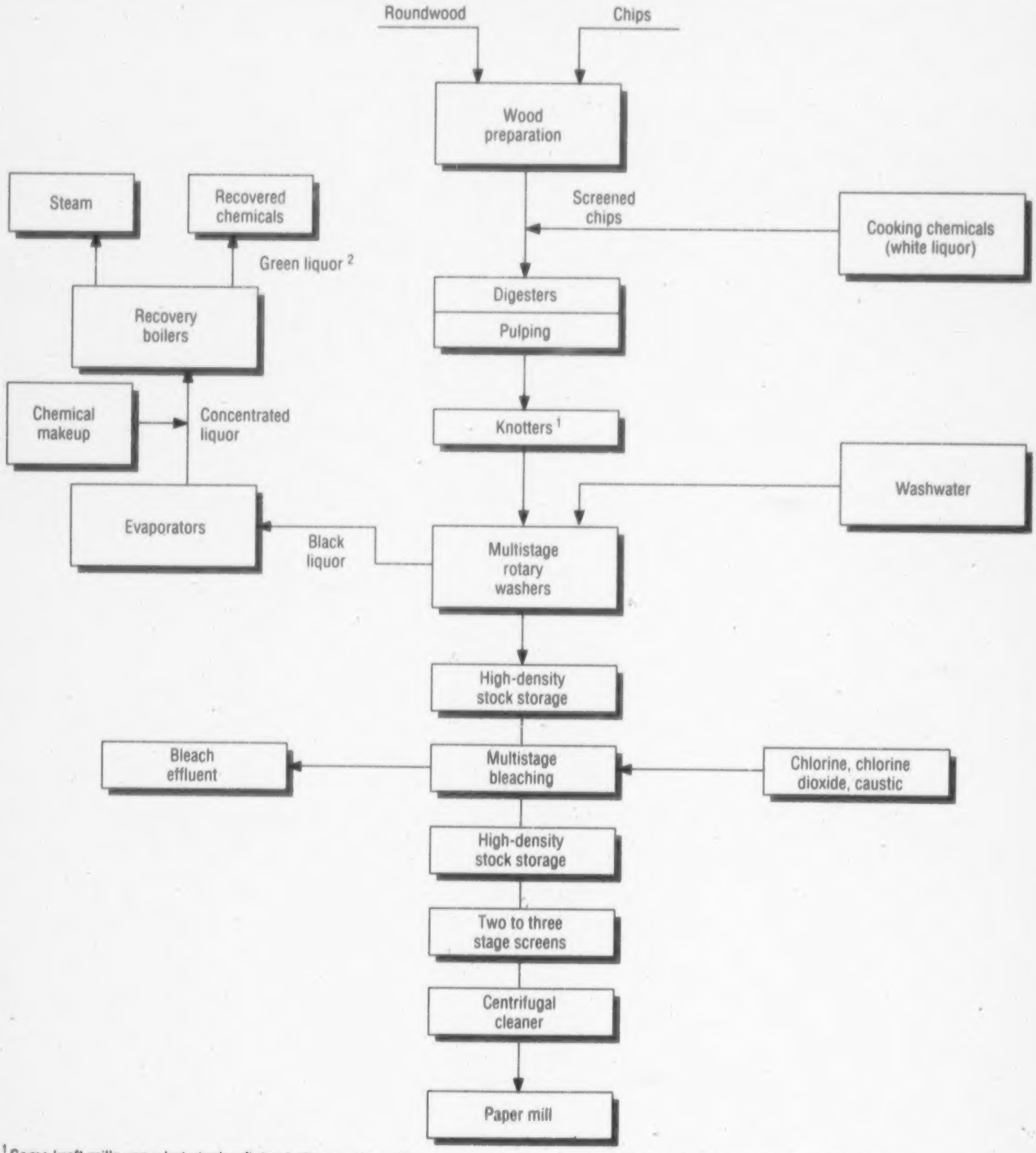
*Includes soda pulp.

e = Estimate.

1. Mainly bleached; unbleached sulfite capacity in 1983 was 400,000 tons.
2. Includes semibleached (1.5 million tons in 1977, the last year for which data were available).
3. Bleached semichemical capacity in 1983 was 361,000 tons.

Source: American Paper Institute.

SIMPLIFIED PROCESS FLOWS FOR KRAFT PULPING


Roundwood
Chips
Wood preparation
Screened chips
Cooking chemicals (white liquor)
Steam
Recovered chemicals
Green liquor [2]
Recovery boilers
Digesters
Pulping
Chemical makeup
Concentrated liquor
Knotters [1]
Washwater
Evaporators
Black liquor
Multistage rotary washers
High-density stock storage
Bleach effluent
Multistage bleaching
Chlorine, chlorine dioxide, caustic
High-density stock storage
Two to three stage screens
Centrifugal cleaner
Paper mill

[1] Some kraft mills use a hot stock refining before washing. These systems use a refiner to defibrate the unbleached pulp after pulping. The defibrated pulp is then screened before washing.

[2] Green liquor from recovery is treated in the causticizing process to process white liquor.

guished. The U.S. produced about 1.4 million metric tons in 1990 and Canada supplied 1.5 million tons, for a total of 2.87 million tons from 39 mills. That compares with a total of 3.9 million tons in 1980.

Lignins are dissolved in a solution of sulfurous acid and bisulfite salts at high temperatures in the sulfite process. The process is carried out in large batch digesters for six to nine hours, depending on pulp quality. A wide range of yields can be produced by the sulfite process. High-yield sulfite (typically called bisulfite pulp) is used for newsprint and has yields of about 55%. Chemical-grade acid sulfite pulp has lower yields in the range of 45%.

Several different chemical bases are used to produce sulfite pulps. Originally, the sulfite pulping process used a calcium base; however, recovery of spent liquors was difficult and uneconomical. Today, sulfite processes are based not only on calcium but also on ammonia, sodium, and magnesium. The sodium- and magnesium-based processes offer full chemical recovery. In the ammonia-based process, liquor is burned for energy, but its ammonia or nitrogen values are not necessarily recovered. However, sulfur dioxide from this process can be recovered.

Sulfite pulps made from either softwood or hardwood are not as strong as their sulfate counterparts, so they are not used in high-strength applications, such as linerboard, bags, and sacks. But they are suited to fine papers, tissue papers, bristols, and other high-quality papers.

SEMICHEMICAL PULPING

Back in the 1920s, when hardwood was not used much for pulpmaking, the Forest Products Research Laboratory in Madison, Wis., developed semichemical pulping to take advantage of this fiber source (the process is also sometimes used with softwood chips and sawdust). It generates pulp with intermediate strength at yields of 60% to 80%, suitable for applications such as corrugating medium.

Semichemical pulping uses mild chemical treatment followed by mechanical defibrating. In the original semichemical process, known as the neutral sulfite semichemical (NSSC) process, hardwood chips are pulped in a solution of sodium sulfite at an alkaline pH. Soda ash is added to buffer the acids formed during pulping. When NSSC pulping was first practiced, it was done in rotary digesters using batch techniques. Most NSSC pulp mills adopted continuous pulping once digesters such as the Pandia, M&D, and Defibrator were developed. Digesting retention time is short in continuous pulping, typically not over 30 min at temperatures exceeding 170°C (338°F). The spent chemicals and organic materials are either washed or pressed from the pulp and then burned in a fluidized-bed incinerator or in specially designed units, such as Tampella's recovery unit.

In the late 1960s, Owens-Illinois developed a nonsulfur-based semichemical process that uses a solution of sodium hydroxide and soda ash to produce pulp equivalent in quali-

U.S. CONSUMPTION OF FIBROUS MATERIALS IN PULP, PAPER, AND BOARD MANUFACTURE[1]

(000 short tons)

			Wastepaper						
Year	Total woodpulp[1]	Total wastepaper[2]	Mixed	News	Corrugated	High-grade pulp substitutes	High-grade deinking	Other[3]	Cotton linter pulp
1989	62,701	17,964	2,424	3,421	8,993	1,310	1,816	254	120
1988	62,764	17,537	2,546	3,234	8,748	1,324	1,684	275	139
1987	61,231	16,618	2,169	3,143	8,345	1,433	1,529	273	105
1986	59,882	15,419	2,115	3,140	7,502	1,253	1,409	288	111
1985	56,639	14,818	2,081	3,031	7,234	1,111	1,360	301	95
1984	50,309	14,944	2,136	3,018	7,231	1,248	1,310	346	92
1983	53,970	14,170	2,059	2,783	6,846	1,262	1,220	334	79
1982	50,186	13,563	1,980	2,790	6,486	1,237	1,148	331	65
1981	52,779	12,872	2,165	2,417	5,919	1,380	991	451	58
1980	51,804	12,583	2,686	2,116	5,628	1,302	851	556	49
1979	51,557	13,012	2,889	2,131	5,737	1,401	854	681	47
1978	49,694	12,481	3,149	3,149	5,187	1,338	786	779	46
1977	49,132	12,103	3,001	3,001	4,839	1,403	784	785	40
1976	47,541	11,874	3,009	3,009	4,618	1,323	771	700	42
1975	42,431	10,367	2,761	2,761	3,950	1,142	650	587	37
1974	48,341	12,098	3,332	3,332	4,669	1,427	615	792	37
1970	43,192	10,594	3,393	3,140	3,511	1,377	493	780	46

1. Woodpulp is also consumed in many nonpaper and board products, such as chemical cellulose, molded pulp products, etc.
2. Census data for wastepaper consumption are lower than those reported by American Paper Institute. See section on wastepaper.
3. Straw, rags, bagasse, etc.

Source: Bureau of the Census.

ty to NSSC pulp. It is adaptable to existing processes with only minor modifications, and more than half of all NSSC pulp producers have shifted to the sulfur-free, soda-based cook.

MECHANICAL PULPING

Mechanical pulping reduces pulpwood to individual fibers through mechanical energy. Pulpmakers initially used the groundwood modified process, in which short logs are fed against a rotating disc called a grinder and the fibers released are washed off into a chest below the grinder for subsequent refining to remove shives and bundles and to develop strength. Friction between the log and the grinder creates high temperatures that plasticize the lignin, limiting damage to the fibers. While the fibers are short, yield is high—up around 90%.

North American groundwood pulp capacity for paper and board production is about 7.7 million metric tpy. Groundwood pulps are ideal for bulky sheets that require good opacity, such as newsprint and low-quality printing grades. However, these pulps have poor sheet strength; thus, kraft or high-yield sulfite pulp must be added to grades such as newsprint so they can run on paper machines and printing presses.

Chips cannot be used with grinders, but they can be refined, with or without preheating, in large disc refiners that discharge to the atmosphere. This refiner mechanical pulping (RMP) process yields pulps with longer fibers and better strength than comparable groundwood pulps, although opacity is not as high. RMP led the way to the use of residual chips in mechanical pulp production, particularly in the Pacific Northwest. Developed in the early 1960s, RMP capacity has grown to about 700,000 metric tpy in North America.

Late in the decade, producers found that presteaming the

U.S. PULP MILLS—SUMMARY OF STATISTICS

Year[1]	All establishments Total (number)	All establishments With 20+ employees (number)	Employees Number (000)	Employees Payroll (million $)	Value added by manufacture (million $)	Cost of materials (million $)	Value of shipments (million $)	New capital expenditures (million $)
1987 Census	39	38	14.2	$536.3	$2,246.0	$1,954.9	$4,213.9	$358.4
1986 ASM	n.a.	n.a.	15.3	593.7	1,590.8	2,212.7	3,837.3	874.6
1985 ASM	n.a.	n.a.	16.3	555.4	1,133.1	2,095.0	3,228.0	745.0
1984 ASM	n.a.	n.a.	16.8	549.0	1,599.4	2,267.3	3,841.1	600.4
1983 ASM	n.a.	n.a.	16.9	508.7	1,239.4	2,003.8	3,261.4	915.7
1982 Census	43	41	16.7	467.5	1,113.8	1,986.5	3,129.0	658.6
1981 ASM	n.a.	n.a.	15.9	408.1	1,221.7	1,960.1	3,141.8	521.5
1980 ASM	n.a.	n.a.	16.2	404.6	1,292.7	1,776.9	3,031.9	258.8
1979 ASM	n.a.	n.a.	15.7	338.9	1,117.2	1,417.2	2,544.1	239.7
1978 ASM	n.a.	n.a.	15.1	306.3	855.5	1,268.0	2,152.4	194.6
1977 Census	45	42	16.2	293.2	885.7	1,212.4	2,071.1	301.1
1976 ASM	n.a.	n.a.	15.7	260.5	974.6	1,087.7	2,055.4	375.0
1975 ASM	n.a.	n.a.	13.1	191.4	821.0	837.0	1,630.4	294.2
1974 ASM	n.a.	n.a.	12.0	163.2	779.3	766.1	1,525.2	135.6
1973 ASM	n.a.	n.a.	10.8	138.2	382.7	464.0	848.5	118.7
1972 Census	60	35	10.6	125.7	306.9	388.1	709.9	136.4
1971 ASM	n.a.	n.a.	14.5	156.3	367.2	496.4	841.8	135.2
1970 ASM	n.a.	n.a.	15.6	160.2	466.3	508.3	960.3	121.6
1969 ASM	n.a.	n.a.	14.9	142.6	362.0	455.2	820.0	132.6
1968 ASM	n.a.	n.a.	15.4	136.0	361.3	431.2	799.3	77.0
1967 Census	61	43	15.1	125.6	333.7	403.2	730.5	121.8
1966 ASM	n.a.	n.a.	14.8	112.3	346.1	320.1	658.5	113.3
1965 ASM	n.a.	n.a.	14.8	112.3	346.1	320.1	758.5	112.2
1964 ASM	n.a.	n.a.	15.3	113.6	331.6	328.6	662.8	66.6
1963 Census	45	40	15.1	107.4	295.8	312.6	609.1	38.9

n.a. = Not available.

1. In years of Annual Survey of Manufactures (ASM), data are estimates based on a representative sample of establishments canvassed annually and may differ from results of a complete canvass of all establishments.

Source: 1987 Census of Manufactures.

chips and refining them under pressure in the disc refiner gave significantly better pulp. In fact, the thermomechanical pulp (TMP) was stronger than producers had thought was possible with a mechanical process. In a typical TMP process, softwood chips are presteamed at 110°C (230°F) for one or two minutes. Next, they are fed via a press feeder or pocket feeder into a pressurized refiner with specially designed plates, and then they are released under pressure into a stock chest. A second stage is used to refine these pulps further.

Other significant developments related to the TMP process occurred over the next several years, including the use of chemicals and variations in the refining stage. Chemithermomechanical pulping (CTMP) was developed in Scandinavia during the late 1970s, and it entails application of chemicals to the chips prior to refining. The process usually begins with an impregnation of 2% to 5% of sodium sulfite and chelating agents with a pH of 9 to 12. The mixture is then preheated for two to five minutes at 120°C to 130°C, and refining follows. Depending on the raw materials and amount of chemicals used, yields for unbleached softwood pulp are in the range of 92% to 96%. If the pulp is bleached with peroxide, a brightness level of about 80 to 82 ISO can be reached. And hardwood can be bleached up to 87—approaching bleached kraft pulp brightness.

CTMP has a number of advantages over TMP. The chemical pretreatment of the chips permits less destructive separation of fibers from the wood, resulting in a higher, longer fiber content and a much lower shive content. The fiber is more flexible, which provides higher sheet density and higher burst and tensile strength. CTMP also has higher brightness before bleaching. And CTMP is better suited for absorbent grades and food packaging because wood extractives are more completely removed. In addition, CTMP beats bleached softwood kraft in terms of opacity and matches it in tear strength. However, CTMP cannot meet this chemical pulp in terms of tensile strength, and color reversion remains a problem with CTMP, as with other mechanical pulps. Another drawback for both TMP and CTMP is the high energy demand of the process. Producers are tackling this problem with new methods such as the pressurized cyclone; this technique improves the recovery of steam, useful in drying pulp or paper.

Newsprint, uncoated groundwood, and coated publica-

CANADIAN PRODUCTION OF WOODPULP

(000 metric tons)

Year	Total all grades[1]	Dissolving and special alpha	Bleached sulfite	Unbleached sulfite	Bleached hardwood sulfate	Bleached softwood sulfate	Semibleached sulfate	Unbleached sulfate	Semichemical	Mechanical
1990	22,836	221	428	1,023	1,597	6,340	863	1,360	465	10,531
1989	23,708	273	415	1,212	1,577	6,868	1,055	1,356	432	10,507
1988	23,818	267	441	1,298	1,409	6,974	1,100	1,463	430	10,420
1987	23,124	241	454	1,296	1,324	6,887	1,169	1,474	440	9,820
1986	21,798	223	428	1,248	1,299	6,324	1,188	1,410	406	9,252
1985	20,481	222	329	1,269	1,174	5,873	1,170	1,383	330	8,714
1984	20,417	221	365	1,405	1,214	5,568	1,065	1,469	410	8,682
1983	19,455	216	304	1,353	1,050	5,693	1,019	1,486	382	7,934
1982	17,237	219	280	1,446	817	5,098	916	1,235	319	6,888
1981	19,326	274	430	1,819	812	5,449	1,057	1,497	322	7,647
1980	19,985	313	405	1,763	832	5,922	1,185	1,689	333	7,521
1979	20,331	311	478	1,806	811	5,471	1,038	2,061	354	7,956
1978	19,783	341	516	1,787	785	5,086	1,054	1,942	318	7,910
1977	17,925	230	636	1,621	680	4,620	1,039	1,574	263	7,226
1976	17,687	222	609	1,649	594	4,672	1,038	1,559	269	7,037
1975	14,850	226	516	1,442	452	3,767	863	1,314	233	6,007
1974	19,359	333	734	1,865	777	4,632	1,096	1,942	329	7,588
1973	18,218	293	507	1,750	893	4,155	1,097	1,922	350	7,196
1972	17,123	370	526	1,711	835	3,556	1,127	1,639	337	6,967
1971	16,235	388	587	1,706	723	3,130	1,150	1,467	301	6,718
1970	16,350	411	684	1,870	3,660[2]		1,084	1,341	285	6,940
1965	13,050	431	817	1,836	1,862		566	1,114	177	6,170
1960	10,255	356	519	1,560	1,062		257	895	203	5,335
1955	9,082	265	566	1,625	663		55	617	141	4,960
1950	7,606	305	386	1,315	396		12	548	94	4,445

1. Excludes defibrated and exploded pulp (51,000 tons in 1986) used mainly in construction grades; about 15,000 tons of screenings are included.
2. Total bleached softwood and hardwood production.
Source: Statistics Canada.

tion papers are major outlets for TMP and CTMP; in fact, these pulps allow manufacturers to cut back or even do without the addition of chemical pulp during newsprint production. Bleached board and absorbent products, mainly tissue and baby diapers, form another market for CTMP, particularly high-freeness softwood grades. Coated and uncoated free-sheet grades utilize low-freeness aspen CTMP from a number of new Canadian market pulp mills.

The rapidly growing TMP/CTMP sector has surpassed groundwood in terms of capacity for paper and board production. Annual capacity in 1990 topped 10 million metric tons in North America.

A number of other mechanical pulping processes are used, including pressurized groundwood (PGW) pulping. This technique was developed by Tampella of Finland and MoDoCell of Sweden in the late 1970s. More than 20 mills use the process in Europe, Japan, and North America, including Madison Paper Co. and Lake Superior Paper Industries, which use the pulp in supercalendered paper, and Blandin Paper Co. and James River Corp. (St. Francisville, La.), which use it to make lightweight coated paper. Overall capacity is above 2 million metric tpy.

PGW incorporates high pressure in the grinding step so the shower water can be heated to a greater temperature (over 95°C) than is typical in conventional grinding. This reduces damage to the woodfibers during separation because it softens the lignin holding the fibers together. PGW pulping has the advantage that it requires only two-thirds the energy needed in the TMP process (or about the same amount of energy as conventional groundwood) but delivers pulp with similar strength.

DEFIBRATED PULP PROCESS

The Masonite process was the first technique employed to make defibrated pulp by steaming chips under pressure in a vessel and releasing them via a gun or nozzle to atmospheric pressure. The explosion blows the pulp into individual fiber masses, which are mixed to make a pulp slurry. With little or no further refining, this slurry can be used to make coarse grades of paper and board, such as insulation or hard-pressed board.

The technology moved ahead in the late 1930s, when Defibrator of Sweden developed its own defibrated pulping process. In the Defibrator process, pulp is fed continuously to a presteaming vessel under slight pressure and reasonably high temperature and is then discharged through a pressurized refiner at the bottom or end of the pulping vessel, where it is defibrated under pressure. The pulp is then discharged to atmospheric pressure to either a live-bottom

CANADIAN WOODPULP CAPACITY

(000 metric tons)

Year	Total all grades	Dissolving and special alpha	Bleached sulfite	Unbleached sulfite	Bleached softwood sulfate	Semibleached softwood sulfate	Bleached hardwood sulfate	Unbleached sulfate	Semichemical	Mechanical
1993e	28,365	247	504	883	8,186	884	2,136	1,561	523	13,441
1992e	28,115	247	504	883	8,138	899	2,134	1,564	523	13,223
1991e	27,561	247	504	962	7,876	906	2,088	1,561	516	12,901
1990	26,525	247	503	1,177	7,577	914	1,807	1,571	504	12,225
1989	25,736	281	538	1,293	7,444	939	1,697	1,540	464	11,540
1988	25,021	277	452	1,399	7,410	962	1,595	1,561	465	10,900
1987	24,740	245	466	1,446	7,201	1,082	1,367	1,543	465	10,445
1986	24,509	245	582	1,438	7,023	1,123	1,279	1,682	456	10,201
1985	23,423	266	572	1,414	6,804	1,085	1,253	1,719	449	9,861
1984	23,305	264	371	1,634	6,578	1,127	1,311	1,735	472	9,813
1983	22,889	267	391	1,734	6,492	1,169	1,121	1,734	462	9,519
1982	22,618	305	436	1,950	6,336	1,236	988	1,759	445	9,163
1981	22,424	303	461	2,119	6,371	1,106	955	1,788	445	8,876
1980	21,864	307	426	2,062	6,252	1,198	879	1,752	438	8,550
1979	22,521	395	512	2,100	6,114	1,258	866	1,807	459	9,010
1978	22,014	424	580	2,091	5,699	1,216	852	1,824	455	8,837
1977	22,251	353	727	2,119	5,535	1,191	848	2,062	454	8,924
1976	22,242	408	807	2,134	5,329	1,189	860	2,157	426	8,894
1975	21,960	427	794	2,131	5,256	1,203	877	2,132	400	8,696
1974	21,641	404	689	2,144	5,027	1,264	867	2,087	390	8,716
1973	20,957	416	622	2,107	4,651	1,249	844	1,967	392	8,652

e = Estimate.

Source: Canadian Pulp & Paper Assn.

storage bin or to a stock chest, where it is diluted to make a stock slurry. If necessary, the pulp is again refined, mainly to break up fiber bundles and develop strength characteristics. It is then fed to either a cylinder- or fourdrinier-type former. The pulp is not diluted with water if it is to be used in a dry process, such as hard-pressed board production. In that case, it is stored in a live-bottom bin and then fed through a distributor line onto a forming wire.

Defibrated pulp can be prepared from softwood or hardwood, depending on the product desired and the availability of timber. The defibrated pulp process is the simplest way of preparing pulp and gives the highest yield with less pollution, but the resultant pulp has poor strength characteristics. Nevertheless, the capacity for making defibrated pulp has grown rapidly during the last 20 years.

DEINKING PROCESS

Recycling is growing in importance, and papermakers are turning increasingly to wastepaper as a fiber source. In many cases, they must deink the wastepaper to remove ink (and in some cases coating and filler) before the recycled fiber can be incorporated into a new paper or board product. Coated ledger as well as old newspapers and magazines are the dominant deinking grades.

Flotation and washing, and combinations of the two, are most often used to deink wastepaper. The washing technique entails pulping the wastepaper with chemicals (soda ash, caustic soda, sodium silicates, surfactants, or solvents) in an open pulper on either a continuous or batch basis. The pulp is then washed free of ink on conventional rotary washers or on side-hill screens. The washed pulp is then screened and bleached.

THERMOMECHANICAL PULPING CAPACITY TRENDS IN U.S. AND CANADA

(000 metric tons)

Year	Canada*	U.S.	Total
1993e	8,609	3,215	11,824
1992e	8,392	3,266	11,658
1991e	7,870	3,229	11,099
1990	6,911	3,145	10,056
1989	5,751	2,945	8,696
1988	5,062	2,812	7,874
1987	4,375	2,691	7,066
1986	4,122	2,413	6,535
1985	3,811	2,267	6,078
1984	3,563	2,225	5,788
1983	3,135	1,985	5,120
1982	2,383	1,858	4,241
1981	1,738	1,563	3,301
1980	1,115	1,244	2,359
1979	717	791	1,508
1978	544	652	1,196
1977	533	514	1,047
1976	380	302	682
1975	69	119	187

*Includes chemi-thermomechanical pulp.
e = Estimate.
Sources: Canadian Pulp & Paper Assn., American Paper Institute.

In the flotation deinking process, air is used to float ink particles off the fibers. The wastepaper is first sent to a pulper with deinking chemicals and cleaned with screens and centrifugal cleaners. The ink is then removed from the fiber by the foaming action of air bubbles and surfactants, and the foam is skimmed from the top of the flotation cell. Sodium peroxide, silicates, foamers (soaps), and a collector are commonly used chemicals in this process.

Several other deinking systems are used, including combination processes that couple a washing system and a flotation unit to clean effluent from the washers. Regardless of the type of system, the pulper is usually run batch, while the deinking line draws from a storage tank and is run continuously. In some cases, however, pulp is removed from the pulper continuously.

Over 60 mills in North America deink wastepaper. More than 50 of them are in the U.S., and about ten are in Canada. Tissue producers account for about 20 of the deinking installations. Fort Howard Corp. is a leader in deinked tissue production, using proprietary technology to process less-expensive wastepaper-based grades. Deinked pulp lines exist at about ten North American printing/writing mills, six linerboard and boxboard mills, and 12 newsprint mills. Four mills owned by Ponderosa Fibres of America Inc., with a combined capacity of 800 tpd, produce deinked market pulp.

NEW PULPING PROCESSES

Interest is growing in the use of organic solvents, such as ethanol and methanol, to remove lignin. The concept of organosolv pulping was first proposed in the early 1930s, but such processes have only recently come close to commercial development.

With assistance from the Canadian federal government in early 1989, Repap Enterprises Corp. Inc. started up a 33-tpd demonstration plant for its Alcell process at Miramichi, N.B. The process uses ethanol and water to dissolve lignin from hardwood chips in an extractor under controlled temperatures and pressures. The lignin separation and liquor recovery system then separates byproducts (sulfur-free lignin and wood sugars) and recycles the ethanol back to the extraction stage. Repap is considering the feasibility of scaling up the process to a 250-tpd commercial facility.

Another variation of the process has been developed in Germany, where a 5-tpd demonstration plant has been operating for several years. The MD Papier Organocell process uses methanol and can be used to pulp softwood chips. An 85-tpd system using this process is being installed at an existing paper mill. Advantages of organosolv pulping include lower capital costs, feasibility of smaller-size "mini-mills," minimal environmental impact due to the absence of chlorine, and production of potentially valuable byproducts. The process, however, requires complex pulp-washing arrange-

GENERAL DESCRIPTION OF COMMERCIAL PROCESSES FOR PULPING WOOD

Pulp classification	Name of process	Process description	Woods used	Yield of pulp by weight (%)	Strength, brightness[1]	Pulp usage	Final products	U.S. capacity 1990 (000 short tons)	Number of pulp mills in U.S. 1989[2]
Dissolving	Pre-hydrolyzed kraft	Woodchips first receive an acid or water hydrolysis to remove pentosans and then are pulped via kraft process. Very high alpha grades receive a cold caustic treatment after kraft pulping.	Softwoods: southern pine. Hardwoods: gum, oak, southern mixed hardwoods.	30-35	Low	Chemically converted into chemicals, plastics, rayon, cellophane, or acetates.		840e	3
	Sulfite	Woodchips first are pulped under special acid sulfite pulping conditions. Higher purity achieved via pressure heat treatment or cold caustic treatment stages.	Softwoods: southern pine, hemlock, spruce. Hardwoods: eastern.	30-35	Low	Same as above.		650e	5
Chemical	Kraft	Woodchips reduced under steam pressure to pulp with alkaline chemicals (sodium hydroxide and sodium sulfide).	Softwoods	42-55 90 ISO bright	Softwoods: high to very high. Hardwoods: medium to medium high.	Higher yield pulp used for containerboard. Lower yield pulp used for numerous grades of paper. Often mixed with other pulps.	Strong wrapping and bag paper, containerboard, book, newsprint, highest grade magazine and other printing papers, bond, writing	Total: 50,896 Bleached and semi-bleached softwood: 14,674	124
			Hardwoods	44-49				Hardwood: 13,202	
	Sulfite	Woodchips reduced under steam pressure to pulp with an acid chemical (calcium, magnesium, sodium, or ammonium bisulfite plus sulfurous acid).	Softwoods: spruce, balsam, hemlock, southern pine. Hardwoods: eastern lake.	46-48 90 ISO bright	Softwoods medium to high.	Usually mixed with other pulps. When purified, used for cellulose products.	Book and magazine, wrapping, tissue, newsprint, glassine, writing, cellulose	1,622	18

GENERAL DESCRIPTION OF COMMERCIAL PROCESSES FOR PULPING WOOD (continued)

Pulp classification	Name of process	Process description	Woods used	Yield of pulp by weight (%)	Strength, brightness[1]	Pulp usage	Final products	U.S. capacity 1990 (000 short tons)	Number of pulp mills in U.S. 1989[2]
Chemical (cont.)	Soda	Woodchips reduced under steam pressure to pulp with an alkaline chemical (caustic soda).	Mostly hardwoods: aspen, cottonwood, basswood, beech, birch, maple, oak, tupelo (gum)	40-48	Medium to medium low	Often mixed with sulfite and other pulps.	Book and magazine, lithograph, other printing papers, envelope, blotting paper	312e	2
Semi-chemical	Neutral sulfite, bisulfite, acid sulfite, kraft, soda, or caustic	Woodchips partially softened under steam pressure with chemicals are reduced to pulp by mechanical action.	Hardwoods: same as for soda pulp. Red alder. Often pulped in mixtures. Softwoods: small amounts of Douglas fir, ponderosa pine, and sugar pine.	60-80	Medium to medium low	Alone in corrugating and some other boards. Bleached pulps mixed with softwood pulps for other products.	Corrugating board, food and other specialty boards, glassine magazine, newsprint, insulating and sheathing board	4,925	36
Chemi-mechanical	Mason (exploded) Asplund (defibrated)	Woodchips treated with steam or hot water at high temperatures and pressures to soften the wood, followed by mechanical fiberization.	Softwoods and hardwoods	80-95	Low to very low	Coarse pulps composed of mixture of single fibers and fiber bundles used alone and mixed with other pulps.	Hardboard, insulating, roofing and linoleum felts	600e	25e
	Cold soda	Woodchips given mild treatment with sodium hydroxide solutions and then mechanically fiberized to pulp.	Hardwoods: birch, maple, beech, oak, sweetgums, aspen. Bagasse. Often pulped in mixtures.	80-95	Medium to low	Often mixed with other pulps.	Printing paper	200e	4e

GENERAL DESCRIPTION OF COMMERCIAL PROCESSES FOR PULPING WOOD (continued)

Pulp classification	Name of process	Process description	Woods used	Yield of pulp by weight (%)	Strength, brightness[1]	Pulp usage	Final products	U.S. capacity 1990 (000 short tons)	Number of pulp mills in U.S. 1989[2]
Mechanical	Groundwood (GWP)	Wood bolts reduced to pulp by pressing on a revolving grindstone.	Softwoods: spruce, balsam, pine, hemlock. Hardwoods: aspen, cottonwood.	91-93	Low 70 bright	Usually mixed with chemical pulp.	Newsprint, magazine, book, catalog, tissue/towel, boxboard, building, insulating board	3,241	71
	Refiner mechanical (RMP)	Woodchips are mechanically fiberized in non-pressurized disc refiners.	Same as GWP	91-93	Low but higher than GWP	Blended with GWP or chemical.	Newsprint	342	6
	Thermo-mechanical (TMP)	Woodchips are first presteamed and fiberized in pressurized disc refiners.	Same as GWP	90	Low but higher than RMP, 80 bright	Same as above.	Newsprint, publication papers, fiberboard	3,522	25e
	Chemi-thermo-mechanical (CTMP)	Woodchips are impregnated with 2% to 5% sodium sulfite prior to refining; otherwise, similar to TMP.		91-93	Higher than TMP, lower than kraft 80-82 bright (swd) 85+ (aspen)	Same as above.	Newsprint, publication papers, tissue/towel, bleached board, fluff	30 (2,800e in Canada)	1 (15+ in Canada)
	Pressurized groundwood (PGW)	Groundwood made by grinding logs in a pressurized atmosphere with grinder at high temperature.	Same as GWP	90-93	Nearly as high as TMP; higher than groundwood	Same as GWP.	Supercalendered papers, coated groundwood	600	7

n.a. = Not available.
e = Estimate.

[1] ISO brightness.

[2] Except for kraft, sulfite, and chemi-thermomechanical pulp, nearly every kind of pulp mill must be integrated with a paper or board mill, with excess production being offered for sale.

ments. Volatile pulping chemicals are also used, which can lead to explosions or fires, and the process may not work well on mixed wood species, according to some independent researchers.

Andritz Sprout-Bauer introduced the alkaline peroxide mechanical pulping process in mid-1989 as an improvement on the conventional prebleach CTMP process. With this technique, chips are fully bleached before refining by impregnating them with peroxide bleach liquor. That eliminates the need for a bleach plant and cuts energy required for refining by as much as 35%.

DESCRIPTIONS OF MECHANICAL PULPING PROCESSES

Groundwood pulp (GW). Groundwood produced by atmospheric grinding of logs with conventional stone grinder.

Pressurized groundwood (PGW). Groundwood produced by grinding logs in a pressurized atmosphere with a conventional grinder.

Groundwood from chips (FGP). Groundwood produced by atmospheric grinding of chips with a modified grinder. There is no common abbreviation: the FGP is used by the Japanese inventors—F for fine, and GP for groundwood pulp.

Refiner mechanical pulp (RMP). Atmospheric refining of untreated chips.

Chemirefiner mechanical pulp (CRMP). Atmospheric refining of chemically treated chips.

Chemi-thermomechanical pulp (CTMP). Produced from chips pretreated with chemicals prior to steaming, then refined in pressurized refiner, with or without subsequent pressurized or atmospheric refining stages.

Thermomechanical pulp (TMP). Produced from chips first presteamed and refined in one or more stages of pressurized refining, or followed by atmospheric refining.

Sodium-sulfite-treated TMP (Opco TMP). Process developed by Ontario Paper Co. that involves treating (cooking) TMP pulp (rather than chips before refining) with sodium sulfite.

Sulfonated chip mechanical pulping (SCMP). Patented process of CIP Inc. that is basically chemical pretreatment of chips followed by atmospheric refining. (Abitibi-Price and Stone-Consolidated both have variations of this process; S-C refers to its process as "Ultra High Yield [UHY]," but this process might be called sulfite pulp or CRMP.)

Tandem TMP. Refers to an arrangement of refiners. For example, single stage only (pressurized); two stages (first only pressurized); three stages (first only pressurized).

The use of anthraquinone (AQ) as a catalyst in kraft and soda pulping has been developed by C-I-L Inc. of Montreal, Que. Mill trials have shown that this organic chemical, when applied in a ratio of about 0.10% to 0.15% to softwood during kraft pulping, typically improves yield by 2% to 3%. It also reduces alkali consumption by 10% to 15% and shortens cooking time. AQ apparently speeds up the removal of lignin, allowing the pulp to retain more hemicellulose.

Kraftanlagen Heidelberg and Feldmühle AG are developing the alkali-sulfite-anthraquinone-methanol (ASAM) cooking process in Germany. The partners have been running a pilot plant since 1989. The technology produces pulp with similar strength to sulfate pulp and at a greater yield (2% to 10% higher). The unbleached pulp's brightness is comparable to sulfite pulp. Chlorine-free bleaching gives a final brightness of 90% ISO. The ASAM process yields no reduced sulfur compounds, and because bleaching can be done without chlorine compounds, no chlorinated organic pollutants are produced.

Stake Technology is working on a steam explosion pulping process in which chemically treated woodchips are fed into a high-pressure steam digester and then exploded to atmospheric pressure. The pulp is then fed to a standard refiner for final defibration and bleached with hydrogen peroxide. The steam explosion technology is also applicable to repulping and deinking wastepaper.

The application of biotechnology to pulping and bleaching continues to interest the industry, although practical programs are still rare. One potential application under study is the use of white rot fungi and other organisms to attack lignin in wood prior to mechanical pulping, cutting down on the energy required for refining. Lignin-degrading enzymes can be used instead. Another option is to remove lignin after pulping. In this case, application of the organism either bleaches the pulp or reduces the amount of chlorine required for that purpose. Again, enzymes can be used instead.

Enso-Gutzeit is one firm studying this approach. The company has conducted trials using hemicellulases and high chlorine-dioxide substitution in the first bleaching stage. This can cut the requirement for chlorine compounds by as much as 30% and reduces formation of chlorinated organic pollutants up to 70%, compared with conventional bleaching sequences.

Fiber:

MARKET PULP

More than three-quarters of the world's woodpulp never leaves the mill in which it is produced; instead, it is used in another part of the facility to make paper and paperboard. In some cases, however, a paper mill may not produce a certain type of pulp, or it may be a nonintegrated facility with no pulping capacity of its own. As a result, the paper mill will fill its requirements from other mills in its own corporate network, or it will purchase pulp from outside market pulp suppliers.

Market pulp is defined as woodpulp produced for sale in open competition with pulp from other producers. It excludes tonnage that is consumed by the producing mill or shipped to any of its affiliated mills within the supply region. With one exception, all pulp exported from supplying countries, including pulp shipped to affiliated enterprises in other countries, is considered market pulp. The exception is the substantial volume of pulp produced in Canada for delivery to affiliated companies in the U.S. These deliveries, amounting to about 1.2 million metric tons in 1990, are considered "tied" pulp and are not included in market pulp statistics. There is some question, however, as to whether or not additional pulp exports should also be considered tied, with the increasing investment by Japanese companies in the Canadian pulp industry and because of North American and Nordic investments in the European paper industry. Market pulp is divided into two basic groups: 1) dissolving or special alpha pulps and 2) paper-grade pulps. Dissolving and special alpha pulps have a high alpha (pure cellulose) content and are used to make rayon, acetate, and other cellulose derivatives as well as specialty papers. Most paper-grade market pulps are produced by chemical processes, although some are made by mechanical methods, such as stone groundwood, thermomechanical pulp (TMP), and chemi-thermomechanical pulp (CTMP).

Chemical paper-grade pulps produced in North America can be further divided according to pulping process (sulfate/kraft or sulfite), basic wood type (softwood or hardwood), production region (northern or southern), and brightness level (bleached, semibleached, or unbleached). The four most important grades of chemical paper-grade pulp are (in descending order of quality, as measured in terms of price) bleached northern and southern softwood and bleached northern and southern hardwood. Fluff pulp (mainly bleached softwood kraft) goes into nonpaper applications, such as baby diapers, but it is included in paper-grade pulp for statistical purposes.

Papermakers in North America are having an increasingly wide range of market pulps to choose from as they try to use the least costly blend of fibers. Eucalyptus pulp from Brazil and the Iberian countries is becoming more accepted for making tissue and other grades. Canadian bleached chemi-thermomechanical pulp (BCTMP) has become availa-

STATISTICS FOR MARKET PULP

(000 metric tons)

	1992e	1991e	1990
U.S.			
Production	7,410	7,020	6,820
Capacity[1]	8,236	7,492	7,145
Utilization rate, %	90.0	93.7	95.4
Apparent U.S .consumption	4,810	4,640	5,037
Imports	2,460	2,420	2,552
Exports	5,060	4,800	4,335
CANADA			
Production	6,900	6,450	6,235
Capacity[1]	8,086	7,893	7,460
Utilization rate, %	85.3	81.7	83.6

e = Estimate.

1. Based on 1990 American Paper Institute and 1991 Canadian Pulp & Paper Assn. capacity surveys.

ble in softwood and aspen varieties. A growing amount of recycled market pulp is entering the market as papermakers respond to pressure to use more wastepaper in their furnish. And papermakers are beginning to substitute an increasing amount of minerals for fiber in their furnishes. One lb of calcium carbonate can replace about 1.2 lb of fiber in making uncoated free-sheet paper and is less expensive.

Most paper-grade market pulp is cut into sheets and sold in bale form; but some is sold in rolls, and a small amount is flash-dried and baled. Integrated paper mills can sell captive pulp on the open market when internal pulp demand is low. When pulp demand is high, these integrated mills may become net pulp buyers or may shift tonnage to affiliated paper mills. Dissolving pulp mills produce either chemical cellulose or paper-grade pulps. As a result, market pulp capacity ratings are inexact and vary with market conditions.

GRADES OF CHEMICAL PAPER-GRADE MARKET PULP

Bleached sulfate (kraft) is the predominant grade of market pulp, with Canadian and U.S. production in 1990 totaling 12.5 million metric tons (including semibleached pulp). The largest percentage of production is made from softwood fibers, such as spruce, fir, and pine. Bleached softwood kraft output totaled 4.8 million tons in Canada and 3.9 million tons in the U.S. in 1990. The most preferred softwood pulps generally are those from mills in western and eastern Canada, the northeastern U.S., and, to a lesser extent, the U.S. Pacific Northwest (where some mills use less desirable species, such as pine and redwood).

Southern U.S. pine pulps are somewhat lower in quality, as the fiber is coarser and produces a poorer sheet for printing/writing grades. With the increasing availability, however, papermakers have learned how to use larger percentages of southern pine pulp in most white paper grades. Nevertheless, southern pine pulps in strong markets sell at about a $30/metric ton discount from northern bleached softwood kraft (NBSK) pulp. In weak markets, the differential may be much larger—in 1990 reaching more than $150/ton.

Bleached hardwood kraft market pulps are produced in the U.S. Northeast and South, with a small amount produced in eastern Canada. Hardwood accounts for about

U.S. PRODUCTION OF MARKET WOODPULP

(000 metric tons)

Year	Total all grades	Dissolving and special alpha	Total chemical paper-grade	Bleached sulfate[1]		Unbleached sulfate	Sulfite
				Softwood	Hardwood		
1990	7,981	1,172	6,810	4,027	2,365	190	228
1989	7,868	1,290	6,568	3,674	2,533	146	215
1988	7,776	1,238	6,532	3,560	2,480	251	241
1987	7,373	1,187	6,187	3,428	2,357	166	222
1986	6,849	1,138	5,729	3,295	2,090	140	204
1985	6,156	1,063	5,093	3,075	1,681	135	202
1984	6,245	1,093	5,152	3,035	1,740	139	238
1983	5,911	1,145	4,766	2,752	1,678	128	208
1982	5,200	988	4,212	2,558	1,356	111	187
1981	5,626	1,224	4,402	2,559	1,471	131	241
1980	5,865	1,366	4,435	2,480	1,491	119	345
1979	5,151	1,360	3,733	2,084	1,298	102	250
1978	4,647	1,273	3,300	1,785	1,200	88	227
1977	4,358	1,327	2,961	1,673	953	124	211
1976	4,413	1,243	3,110	1,659	1,062	102	287
1975	3,953	1,118	2,794	1,777	891	79	292
1974	4,663	1,461	3,168	1,428	1,093	173	360
1973	4,468	1,356	3,093	1,384	1,040	100	441
1972	4,559	1,519	2,996	1,300	1,023	106	436
1971	4,204	1,524	2,687	1,096	842	200	378
1970	4,491	1,555	3,350	1,190	1,075	330	534
1965	3,486	1,347	2,075	1,298[2]	n.a.	214	563
1960	2,717	1,019	1,685	897[2]	n.a.	262	526
1955	2,429	880	1,522	767[2]	n.a.	204	551
1950	1,454	428	978	261[2]	n.a.	113	604

n.a. = Not available.
1. Includes semibleached and soda pulp.
2. Softwood and hardwood.
Source: American Paper Institute.

37% of U.S. and 15% of Canadian bleached sulfate market pulp production. Canadian and U.S. hardwood sells at about a $10/metric ton premium to southern U.S. hardwood, although in the last market downturn the gap became much larger. Southern hardwood pulps are usually sold as mixed hardwoods, which may include oak. Oak and other species high in vessels cause excess picking on offset printing grades, although papermakers have reduced the picking tendency so that problems are not too serious for printers.

Hardwood pulps, blended with or without softwood pulps, make an excellent printing/writing grade, providing bulk and a good printing surface. Hardwood kraft market pulps are generally sold at a $20 to $30/ton discount from softwood kraft grades produced in the same region, but in weak markets the differential grows.

A newer type of hardwood pulp not produced domestically but increasingly popular in North America and around the world is bleached eucalyptus kraft pulp. About 15% of U.S. hardwood pulp consumption now consists of eucalyptus pulp from Brazil, with another 1% to 2% from Spain and Portugal. Since breaking into the world pulp scene about a decade ago, eucalyptus shipments have grown from 434,000 tons in 1976 to more than 3 million tons currently. Originally, its popularity was due to lower costs combined with desirable performance features ranging from opacity in printing/writing papers to softness in tissue. As a result, eucalyptus has become a preferred pulp, selling at a price at least equal to the best northern hardwood grades in Europe and the U.S.

Of the estimated 3.2 million tons of bleached eucalyptus market pulp capacity in the world in 1989, about 38% was held by Brazil, 30% by Spain, 25% by Portugal, 4.6% by South Africa, and 2.5% by Morocco. Eucalyptus can be grown rapidly. The time required for a eucalyptus plantation to reach maturity in Brazil is about seven years, compared with roughly 20 years for southern U.S. loblolly pine and perhaps 80 years or more for Canadian spruce and fir. According to Ronald J. Slinn, vice president, Pulp Materials & Technology Group of the American Paper Institute, eucalyptus plantations in Brazil will produce more than 40 m^3/hectare annually—about 20 times the growth rate of the average Canadian forest and almost three times that of a southern U.S. forest. Productivity in Spain and Portugal is lower than in Brazil but still higher than in the southern U.S.

U.S. MARKET WOODPULP CAPACITY

(000 metric tons)

Year	Total all grades	Dissolving	Total					Others
			Chemical paper grade	Bleached sulfate (kraft)[1] Softwood	Bleached sulfate (kraft)[1] Hardwood	Unbleached sulfate	Sulfite	
1993e	9,658	1,386	8,272	4,911	2,967	142	253	—
1992e	9,624	1,386	8,239	4,832	3,017	142	249	—
1991e	8,880	1,386	7,495	4,296	2,809	142	249	—
1990e	8,530	1,383	7,147	4,103	2,654	142	249	—
1989	8,210	1,329	6,879	3,856	2,633	152	238	—
1988	8,081	1,315	6,759	3,703	2,639	170	248	6
1987	7,716	1,259	6,444	3,646	2,388	152	257	13
1986	7,293	1,266	6,015	3,398	2,224	132	260	13
1985	7,247	1,312	5,923	3,386	2,133	131	274	13
1984	6,831	1,349	5,469	5,063		132	274	13
1983	6,726	1,378	5,335	4,874		142	319	13
1982	6,422	1,450	4,986	4,572		129	261	11
1981	6,325	1,432	4,876	4,416		151	309	15
1980	6,170	1,430	4,653	4,163		156	335	87
1979	5,746	1,407	4,247	3,836		94	318	92
1978	5,213	1,427	3,691	3,314		97	280	94
1977	4,960	1,461	3,498	2,975		149	273	101
1976	4,905	1,289	3,616	2,896		198	416	105
1975	4,910	1,350	3,560	2,919		192	417	31
1974	5,041	1,484	3,557	2,940		173	427	17
1973	4,867	1,442	3,425	2,814		134	458	18
1972	4,910	1,560	3,349	2,774		124	451	—
1971[2]	4,498	1,597	2,901	2,251		218	432	—

e = Estimate.

1. Includes semibleached.

2. First year in which market pulp capacity was reported by API.

Source: American Paper Institute.

North American market sulfite pulp production in 1950 exceeded sulfate production, and for many years sulfite pulps were considered the most desirable type for papermaking. But by 1990, production of bleached and unbleached sulfite market pulp dropped to only 495,000 metric tons, accounting for less than 4% of total North American chemical paper-grade market pulp production. This trend is expected to continue with the shutdown of small, older mills and little new construction of sulfite pulp mills. The same declining trend has developed in the Nordic countries, where sulfite currently accounts for about 9% of chemical paper-grade market pulp capacity.

Most North American sulfite pulp is produced from northern and eastern softwoods (spruce, pine, fir, and hemlock). ITT Rayonier Inc. at Fernandina Beach, Fla., produces paper-grade and dissolving pulp grades from southern pine. A few U.S. and Canadian mills produce sulfite pulp from hardwoods. Sulfite pulps are still highly desirable for producing high-quality tissue and printing/writing papers.

Unbleached kraft market pulp production has declined in North America. The total 1990 production of 311,000 tons accounted for only about 2% of North American chemical paper-grade market pulp production. About 30% to 40% of unbleached kraft market pulp in the U.S. is used in one-time carbonizing tissue, a market that is shrinking due to inroads by carbonless copy paper. Other end uses for unbleached kraft market pulp are filter papers, cable wrap, condenser papers, twisting grades, and other specialties.

NORTH AMERICAN INDUSTRY STRUCTURE

The U.S. pulp and paper industry is highly integrated, and market pulp accounts for only a small percentage of total woodpulp production or consumption. Of the 69 U.S. companies that produce paper-grade pulp, only 25 sold any pulp in 1990, according to API. Many of the 212 companies in the U.S. paper industry also buy significant quantities of pulp, but at least 143 of these must purchase all of the fiber they require, including wastepaper.

In 1990, the U.S. paper industry produced 56.0 million metric tons of chemical paper-grade pulp, of which 84% was consumed on site, 4% was shipped to affiliated mills within the U.S., 4% was shipped to the domestic market, and 8% was exported, according to API. Apparent U.S. paper-grade woodpulp consumption in 1989 totaled 55.2 million tons, of which 84% was supplied by integrated sources within the U.S., 4% by U.S. affiliates, 4% by the domestic market, and 8% by imports. U.S. paper industry pulp imports in 1990 totaled 4.2 million tons, of which 90% was supplied by Canadian producers. The remaining 10% came from Brazil, the Nordic countries, Chile, Portugal, Spain, and Swaziland.

In 1990, Canadian paper-grade pulp shipments to the U.S. were approximately 3.8 million metric tons, of which 32% was tied shipments from Canadian affiliates of U.S. paper companies.

Market pulp accounts for a larger share of total Canadian chemical paper-grade pulp production, which totaled about 12.5 million metric tons in 1989 (latest statistics). Of this amount, 34% was consumed on site or by affiliated mills, 7% was shipped as market pulp to domestic mills, 27% was shipped to the U.S. (including roughly 1.1 million tons of tied pulp), and 32% was exported abroad, according to Canadian Pulp & Paper Assn. data. About 30 companies in Canada sell chemical paper-grade market pulp.

U.S. consumption of chemical paper-grade market pulp has grown at a 2% average an-

MACHINE-DRIED WOODPULP CAPACITY

(000 metric tons)

Year	Total	Dissolving	Sulfite	Bleached sulfate	Unbleached sulfate	Other
1993e	11,792	1,386	386	9,699	174	146
1992e	11,752	1,386	369	9,677	174	146
1991e	11,009	1,386	369	8,934	174	146
1990	10,618	1,383	368	8,544	174	146
1989	10,263	1,329	364	8,237	185	146
1988	10,178	1,315	413	8,303	178	147
1987	9,747	1,265	374	7,999	152	108
1986	9,443	1,269	367	7,568	132	108
1985	9,315	1,313	358	7,417	130	106
1984	8,850	1,349	364	6,904	132	100
1983	8,618	1,455	377	6,555	132	99
1982	8,615	1,457	406	6,521	137	94
1981	8,462	1,450	450	6,291	172	98
1980	8,304	1,442	472	6,052	171	170
1979	7,779	1,393	486	5,625	99	176
1978	7,432	1,427	516	5,204	107	176
1977	7,235	1,495	579	4,818	161	181
1976	7,170	1,425	714	4,642	205	183
1975	7,167	1,516	709	4,608	217	119
1974	7,235	1,655	740	4,555	193	93
1973	6,994	1,596	728	4,392	191	88
1972	6,807	1,593	709	4,266	226	10
1971	6,717	1,605	609	4,173	245	4
1970	6,574	1,604	755	3,977	237	1

e = Estimate

Source: American Paper Institute

nual rate over the past decade. Printing/writing papers account for more than half of all chemical paper-grade market pulp consumed in the U.S. But consumption of "white" market pulp has been declining as a percentage of U.S. printing/writing paper production—from more than 35% in the early 1970s to around 27% in 1989. This pattern suggests "that an increasing proportion of new U.S. printing/writing paper capacity is integrated to pulp," according to Slinn. The tissue/towel segment is the second largest source of U.S. demand but has increasingly been turning to use of secondary fiber and BCTMP. Fluff pulp for use in baby diapers and other sanitary products accounts for just under 20% of U.S. chemical paper-grade pulp consumption. The final large end-use segment is specialty packaging and industrial papers made up of mostly small, nonintegrated paper mills.

U.S. demand for market pulp is closely related to the level of U.S. paper production, particularly of printing/writing grades. In recent years, when U.S. printing/writing paper mill operating rates exceeded the low-90% range, the amount of white market pulp consumed in relation to total white pulp usually rose above 20%. If operating rates are below 90%, however, the ratio of market to total paper pulp consumption often drops into the 18% to 19% range. (White pulp includes bleached and semibleached kraft and bleached and unbleached sulfite.)

The main reason for this swing is that when many integrated companies run at full capacity, they must supplement their own pulp supplies by purchasing fiber on the open market. At the same time, some companies may stop selling pulp in the open market because they must supply their own integrated requirements during a strong market, thus contributing to the cyclicality of the market. However, overall market pulp capacity tends to creep higher in tight markets, as existing mills are debottlenecked or as production is shifted to higher-yield grades (e.g., from softwood to hardwood or from dissolving to paper-grade pulp). U.S. chemical paper-grade market pulp capacity was revised upward by 850,000 metric tpy during the 1987-88 period.

INTERNATIONAL MARKET

The pulp market is international in nature, with large volumes of pulp moving duty-free between net-producing

U.S. EXPORT TRENDS FOR WOODPULP

(000 metric tons)

Year	Total all grades	Dissolving and special alpha	Sulfite bleached	Sulfite unbleached	Sulfate bleached	Sulfate semibleached	Sulfate unbleached	Other
1989	5,657	759	407[1]	n.a.	4,262[2]	n.a.	165	64
1988	5,016	785	356	27	3,644[2]	n.a.	158	46
1987	4,416	681	338	35	3,197[2]	n.a.	141	24
1986	4,044	645	288	24	2,886	17	131	53
1985	3,443	572	227	20	2,474	37	86	26
1984	3,260	540	239	9	2,272	69	82	49
1983	3,306	587	255	12	2,277	52	87	36
1982	3,080	573	190	7	2,139	57	90	25
1981	3,336	720	247	11	2,193	60	92	22
1980	3,452	698	292	23	2,180	84	103	73
1979	2,662	693	199	34	1,481	97	94	64
1978	2,358	687	172	18	1,270	84	69	56
1977	2,395	722	175	7	1,174	147	95	74
1976	2,284	662	164	11	1,180	95	103	67
1975	2,327	628	223	21	1,427	117	87	38
1974	2,252	714	259	22	1,308	81	141	16
1973	2,126	668	266	6	1,003	114	65	5
1972	2,044	720	205	2	1,092	115	70	3
1971	1,974	717	184	9	787	132	137	8
1970	2,808	778	326	31	1,192	223	230	11
1969	1,907	674	228	13	733	138	115	7
1968	1,738	609	206	8	578	191	134	11
1967	1,561	551	219	12	471	179	120	9
1966	1,404	511	190	24	326	126	99	9
1965	1,272	485	183	35	329	126	155	6

n.a. = Not available.

[1] Includes unbleached.

[2] Includes semibleached.

Source: U.S. Dept. of Commerce.

regions and net-consuming regions. North America and the Nordic countries are the largest market pulp producing regions, although nontraditional supplying countries with fast-growing plantations—Brazil, Portugal, Spain, and Chile—are growing in importance.

After rising for six consecutive years, world chemical paper-grade market pulp shipments peaked at 26.7 million tons in 1988 and then declined by 5% over the next two years to about 25.3 million tons in 1990, mainly due to customer inventory liquidation. Shipments from North American and Nordic producers totaled 17.1 million tons in 1990, down 6.2% from the previous year. For the first time, the U.S. surpassed Canada in chemical paper-grade market pulp shipments due to more aggressive pricing and significant mill downtime by Canadian producers. U.S. shipments of 6.7 million tons were up 3.2%, while Canadian shipments of 6.0 million were down 13.1% from 1989. Nordic shipments totaled 4.4 million tons, down 8.9%.

During the past decade, world shipments of chemical paper-grade pulp have grown at a 2.2% average annual rate. While shipments by North American and Nordic producers grew at a 1.5% rate over the 1980-89 period, deliveries by nontraditional suppliers, led by Brazil and Portugal, have grown more than twice as quickly. As a result, their share of the world total increased from 26% in 1980 to 30% by 1989. The share held by North American and Nordic producers declined from 74% in 1980 to 70% by 1989 and is expected to continue to decline as substantial new capacity starts up in countries such as Brazil and Chile.

Western Europe (excluding Scandinavia) remains the largest destination for world chemical paper-grade market pulp shipments, accounting for about 40% of total shipments. In 1990, Western Europe consumed about 10.6 million tons of pulp, down 4% from the previous year. The U.S. was the second largest market, consuming 4.9 million tons, down 5% from 1989. Japan was the third largest market, with demand of 2.7 million tons, down nearly 20% from 1989 due to inventory reduction and new domestic capacity. Other regions of the world—Asia, Latin America, and Africa—consumed about 4.6 million tons of market pulp in 1990, up nearly 8% from 1989.

PULP MARKET CYCLES

The pulp market is highly cyclical, characterized by sharp inventory swings and rising or falling prices. When prices begin to rise, buyers rush to stock up on pulp. Rising shipments enable producers to run at full capacity and reduce their inventories. The tighter market emboldens them to demand still higher prices. This triggers another surge of buying and another spiral upward in the market cycle.

High pulp prices cause consuming paper mills to use substitutes, such as secondary fiber (wastepaper), or to increase their captive pulp production. Prices may still rise after actual pulp consumption by paper mills has begun to decline. At some point, buyers realize that more than enough pulp is available and begin to reduce their inventories. Prices start to weaken, and buyers hold off on making any purchases in anticipation of lower prices. The downward market spiral is under way, and it may not stop until prices approach the break-even level for the average North American/Nordic producer, which usually triggers widespread industry production curtailments.

Market pulp cycles are also loosely related to underlying demand and supply conditions and to the general economy. Demand for market pulp is affected by production levels for paper and paperboard, which, in turn, reflect general economic activity. But the pulp market has sometimes gone down when the economy is strong or staged a recovery when general business conditions are weak. Ross Hay-Roe of *PaperTree Letter* has noted that sometimes a two-year lag occurs between turning points in the U.S. economy and changes in pulp prices.

Capital investment in the market pulp industry usually comes in surges during periods of rising prices and profitability. New mill construction usually takes two to three years. Once the wave of new capacity comes onstream, the market may weaken, resulting in oversupply and declining prices. As profitability declines, companies rein in capital spending, slowing down capacity expansion and setting the stage for the next period of market tightness.

Barometers used to gauge price changes include North American and Nordic producer inventories and operating rates for chemical paper-grade market pulp. Historically, market pulp prices tend to rise when ratios of shipments to capacity reach about 92% to 93% and when inventories of North American and Nordic produc-

SOURCES OF MARKET PULP CONSUMED IN THE U.S.

(000 tons)

Year	Domestic market pulp shipments	% of total	Market pulp imports	% of total	Total apparent consumption
1990	2,354	48%	2,536	52%	4,890
1989	2,425	47	2,723	53	5,148
1988	2,623	48	2,891	52	5,514
1987	2,557	48	2,753	52	5,310
1986	2,507	49	2,610	51	5,117
1985	2,355	50	2,318	50	4,673
1984	2,411	50	2,418	50	4,829
1976	1,679	44	2,116	56	3,759
1970	1,503	44	1,882	56	3,385

Source: American Paper Institute.

ers drop to around 1.2 to 1.3 million tons. When operating rates decline below this level and inventories increase, prices usually (but not always) begin to weaken.

API's Slinn has noted that from about 1970 to 1982, a curiously consistent two-year-nine-month time span existed between peaks and troughs in North American and Nordic producer inventory levels. This made the entire cycle (from peak to peak or trough to trough) slightly more than five years. However, the pattern broke in 1982, when, after only 19 months, a nine-week strike in British Columbia caused producer inventories to hit a low of 911,000 tons in March 1984. The next peak of 1.8 million tons came in February 1985, after only 11 months. Inventories reached a new low of 676,000 tons in December 1987—just over the two-year-nine-month historical pattern. This particular crystal ball, however, is a bit cloudy since inventories at the end of 1988 dropped to almost the same level—673,000 tons. Interestingly enough, however, inventories in the current down cycle appear to have peaked at 1.75 million tons at the end of August 1991—two years and eight months after the December 1988 low.

In addition to labor negotiations (particularly in British Columbia), another external factor that can affect the pulp market is governmental policy. Producer inventories hit an all-time high of 2.9 million tons in February 1977 due to a Swedish government program to subsidize inventory building to keep employment levels high.

Exchange-rate fluctuations have also had a growing impact on pulp prices. Fluctuations in the value of the dollar upset comparative cost relationships among major producing regions, and they affect the price of pulp for buyers in terms of their local currencies. The rise of the dollar during the 1980-84 period dramatically increased the cost advantage of Scandinavian and nontraditional producers, enabling them to price pulp more competitively. At the same time, weak currencies increased the cost of dollar-priced pulp for buyers in Europe and other overseas markets and made them more resistant to pulp price increases. The dollar's decline since 1985 has dramatically improved the cost position of North American producers, and it made price increases more acceptable to buyers in Europe and Japan while strong market conditions persisted through first-half 1989.

CANADIAN MARKET PULP SHIPMENTS BY GRADE

(000 metric tons)

			Total						
							Sulfite		
Year	All grades[1]	Dissolving and special alpha	Chemical paper grade	Bleached sulfate (kraft)[2] Softwood	Bleached sulfate (kraft)[2] Hardwood	Un-bleached sulfate	Bleached	Unbleached	Mechanical
1990	7,208	207	6,053	4,798	871	133	251		945
1989	8,164	268	6,969	5,682	919	98	254	16	923
1988	8,204	268	7,235	5,938	875	103	296	23	698
1987	8,084	243	7,259	5,947	862	117	309	24	579
1986	7,558	239	6,764	5,541	781	132	291	19	552
1985	6,745	216	6,058	4,929	733	154	225	17	469
1984	6,613	221	5,845	4,696	768	154	213	23	535
1983	6,795	210	6,219	5,082	731	188	184	34	365
1982	5,611	226	5,124	4,210	524	179	165	46	257
1981	6,498	270	6,024	4,886	593	225	249	71	199
1980	7,024	310	6,476	5,301	587	231	270	87	223
1979	6,683	371	6,312	5,448		262	284	84	234
1978	6,521	360	5,952	5,342		243	287	80	209
1977	5,742	268	5,325	4,643		291	336	55	149
1976	5,541	241	5,137	4,446		275	340	76	163
1975	4,671	206	4,325	3,655		316	293	61	140
1974	6,179	350	5,654	4,774		375	347	158	175
1973	5,677	252	5,252	4,468		425	272	87	173
1972	4,927	244	4,555	3,851		350	281	73	128
1971	4,238	272	3,859	3,185		254	307	113	107
1970	4,717	317	4,250	3,392		292	381	185	150
1965	3,036	300	2,542	1,565		206	512	259	194
1960	1,807	192	1,479	780		225	310	164	136
1955	1,800	324	1,234	384		222	367	321	182
1950	1,457	291	1,252	370		196	289	397	240

1. Includes screenings (about 3,000 tons in recent years.)
2. Includes semibleached.
Source: Canadian Pulp & Paper Assn.

Under 1984 price-fixing settlements with the European Community, Nordic producers price their pulp in European currencies. Although this measure was intended to reduce the transparency of the market, local currency prices in fact tend to equalize with the dollar price of pulp. The ruling was designed to help European pulp buyers, who were being scissored between expensive dollar-priced pulp and increasing shipments of Nordic white paper pulp priced in local currencies. Ironically, the dollar began to decline not long after the ruling was made.

The combination of volatile exchange rates and dual-currency pricing tends to lubricate the movement of prices upward in a tight market and probably made them come down faster in the recent weak market, according to Hay-Roe. During the tight 1986-88 pulp market, North American producers used any weakness in the dollar as an excuse to raise their dollar prices to the level of local currency prices in Europe. Likewise, any strengthening in the dollar during this period was used by Nordic producers as an excuse to raise their local currency prices to North American dollar price levels in Europe. The result was an almost continuous series of dollar and/or local currency price increases from 1986 to mid-1989. With market conditions and the dollar weakening, local currency prices have dropped even more rapidly than dollar prices since 1990.

RECENT MARKET CONDITIONS

World market pulp prices peaked in first-half 1989 and then began another cyclical decline that extended through most of 1991. The price of NBSK pulp reached $840/metric ton c.i.f. in northern Europe in second-quarter 1989—the last of 13 almost consecutive quarterly price increases, during which time the dollar price more than doubled. But already in the second quarter signs of difficulty were seen when producers were unable to push through a hardwood pulp price—followed later in the year by reports of growing spot discounting on southern mixed hardwood.

The perception that pulp prices had finally peaked and were coming down caused pulp consumers in Europe and Japan to begin holding off on pulp purchases in fourth-quarter 1989. U.S. pulp producers went through a similar inventory adjustment earlier in 1989 in response to a downturn in white paper production caused by inventory liquidation at the printer/converter/distributor level. As a result, world shipments of chemical paper-grade pulp declined 1.6%, or by about 400,000 tons, to 26.3 million tons in 1989 from the previous year—the first such decline since 1982. Producer inventories at North American and Nordic mills began to rise sharply from a low of 673,000 tons at the end of 1988 to 1.03 million tons by the end of 1989.

CANADIAN MARKET PULP CAPACITY

(000 metric tons)

Year	Total	Dissolving and special alpha	Sulfite bleached	Sulfite unbleached	Sulfate bleached softwood	Sulfate semibleached	Sulfate bleached hardwood	Sulfate unbleached	Mechanical
1993e	10,229	247	303	0	6,144	296	1,283	105	1,851
1992e	9,992	247	302	0	6,106	293	1,280	105	1,659
1991e	9,499	247	301	0	5,946	307	1,234	105	1,359
1990	8,811	247	296	20	5,685	313	1,027	119	1,104
1989	8,817	281	302	41	5,714	316	969	104	1,090
1988	8,412	277	299	24	5,665	376	913	113	745
1987	8,179	245	307	24	5,533	473	873	125	599
1986	7,985	245	292	24	5,396	501	809	129	589
1985	7,769	266	270	35	5,233	420	794	177	574
1984	7,670	264	240	39	5,134	405	869	198	521
1983	7,641	201	250	72	5,130	453	780	208	500
1982	7,617	305	286	83	5,128	438	669	236	472
1981	7,430	303	313	84	5,056	433	634	290	317
1980	7,237	307	265	95	4,905	550	605	270	240
1979*	7,112	395	257	106	4,733	524	579	253	265
1978	7,381	424	354	187	4,739	537	590	297	253
1977	7,273	353	425	200	4,514	586	565	370	260
1976	7,224	408	527	202	4,306	562	621	339	259
1975	7,156	427	541	194	4,164	627	613	329	261
1974	6,955	404	472	192	3,976	742	594	354	221
1973	6,502	416	358	149	3,693	664	666	362	194

*Not comparable with previous years' data due to change in method for estimating capacity.
e = Estimate.
Source: Canadian Pulp & Paper Assn.

The price of U.S. southern pine and mixed hardwood began to fall sharply during the first five months of 1990. The price of southern pine in Europe dropped from a list of $810 in fourth-quarter 1989 to about $650, while the price of southern mixed hardwood skidded from a list of $780 to about $600 by spring 1990. Many Canadian and Nordic producers, however, adopted a strategy of taking downtime to reduce inventories rather than dropping prices—instead of trying to compete with lower-cost southern U.S. mills on price. "Why fight a war you can't win," remarked one Canadian pulp producer.

This situation created an unprecedented gap of more than $150 to $200/ton between the price of northern and southern softwood, while a smaller but unusually large gap opened between northern hardwood (and eucalyptus) and southern U.S. hardwood in first-half 1990. Such a price gap did not go unnoticed by papermakers, who began to substitute more southern softwood and hardwood at the expense of northern pulp. In Japan, customers shifted heavily to use of southern pine (and sharply reduced all hardwood pulp purchases due to domestic industry capacity expansion).

The share of total North American and Nordic chemical paper-grade market pulp shipments from Canadian producers in 1990 declined to 35.4%, compared with 38.2% in 1989. Canadian mills in 1990 ran at only 84% of capacity, while operating rates for U.S. producers averaged 95%. U.S. exports of chemical paper-grade market pulp have climbed dramatically since 1983, reflecting the declining dollar and recent weakness in the U.S. domestic market. U.S. exports of chemical paper-grade market pulp rose from about 2.1 million tons in 1982 to 4.4 million tons by 1990.

The declining dollar was a factor that helped Canadian producers keep the price of NBSK at $840 through first-half 1990. Nordic producers, however, were forced to reduce their local currency prices in Europe for NBSK at the beginning of the year to DM1,400/metric ton c.i.f. from DM1,630 in the case of Germany. By mid-1990, the pressure had become too great, and Canadian producers dropped their NBSK list price to $800/metric ton in Europe

CANADIAN EXPORTS OF WOODPULP[1]

(000 metric tons)

Year	All grades[2]	Dissolving and special alpha	Sulfite bleached	Sulfite unbleached	Sulfate bleached hardwood	Sulfate bleached softwood[3]	Sulfate unbleached	Mechanical
1990	7,884	241	401	42	641	5,493	136	930
1989	8,242	224	348	41	812	5,829	95	893
1988	8,407	219	378	47	792	6,227	108	636
1987	8,241	213	395	40	591	6,358	112	312
1986	7,619	216	388	48	529	5,795	137	346
1985	7,025	174	292	49	507	5,391	152	360
1984	7,040	182	313	61	519	5,279	156	379
1983	6,823	177	283	50	477	5,321	166	314
1982	6,099	174	295	101	359	4,665	230	272
1981	6,744	221	424	86	429	5,026	281	270
1980	7,248	235	396	108	409	5,579	210	311
1979	7,090	241	482	104	341	5,358	248	317
1978	6,638	210	509	83	350	4,952	243	291
1977	6,092	130	564	81	341	4,404	295	276
1976	6,116	147	515	92	341	4,473	262	286
1975	5,001	125	414	82	285	3,565	331	189
1974	6,438	243	532	141	306	4,573	373	262
1973	5,939	208	385	107	381	4,148	448	253
1972	5,536	283	369	100	411	3,738	377	249
1971	5,149	316	387	115	392	3,375	342	210
1970	5,063	302	440	162	345	3,220	328	251
1965	3,495	349	570	239	1,703		333	284
1960	2,360	220	394	154	1,016		314	213
1955	2,146	299	415	337	608		201	238
1950	1,675	263	243	374	356		172	225

1. Includes some pulp shipped to mills in the U.S. that have the same ownership. Such "tied" pulp, which totals about 1.0 million tons, is not included in market pulp shipments.
2. Total includes unspecified grades (not shown). Years 1950-60 include small amounts of soda pulp (not shown).
3. Includes semibleached sulfate exports (about 350,000 tons in recent years).

Source: Statistics Canada.

CHEMICAL PAPER-GRADE MARKET PULP CAPACITY OF MAJOR NORTH AMERICAN PRODUCERS

		Annual capacity (000 metric tons)			Capacity share (%)
		U.S.	Canada	Total	
1.	Weyerhaeuser[1,2,4,5]	920*	620	1,540	10.0%
2.	Georgia-Pacific[1,2,4,5]	1,530	—	1,530	9.9
3.	Parsons & Whittemore[1,2]	860*	250	1110	7.2
4.	Canadian Pacific[1,2]	—	930	930	6.0
5.	Stone Container[1,2]	250a	495	745	4.8
6.	Champion International[1,2]	245	465b	710	4.6
7.	Fletcher Challenge[1]	—	665c	665	4.3
8.	Canfor[1,3]	—	585d*	585	3.8
9.	Federal Paper Board[1,2]	540	—	540	3.5
10.	MacMillan Bloedel[1,2,3]	—	500	500	3.2
11.	Noranda[1,2,4]	—	480	480	3.1
12.	Repap Enterprises[1,3]	—	480	480	3.1
13.	Daishowa[1,2]	—	428e	428	2.8
14.	Kimberly Clark[1,5]	225	150	375	2.4
15.	Procter & Gamble[1,5]	100	250	350	2.3
16.	ITT Rayonier[1,4,5]	340	—	340	2.2
17.	Boise Cascade[1,2]	280	50	330	2.2
18.	Simpson Paper[1,3]	320	—	320	2.1
19.	James River[1,2]	170	150	320	2.1
20.	Bowater[1,2]	310	—	310	2.0
21.	Western Forest Products[1,4,5]	—	260	260	1.7
22.	Louisiana-Pacific[1,4]	230	—	230	1.5
23.	E.B. Eddy[1,2]	—	210	210	1.4
24.	Irving Pulp & Paper[1]	—	200	200	1.4
25.	Donohue[1]	—	195e	195	1.3
26.	Domtar[1,2,3]	—	185	185	1.3
27.	Union Camp[1,2]	185*	—	185	1.2
28.	Malette Kraft Pulp[1]	—	180*	180	1.1
29.	Pope & Talbot[1]	180	—	180	1.1
30.	Mead[1]	—	160	160	1.0
31.	Chesapeake[2]	155	—	155	1.0
32.	Stora Forest[4]	—	150	150	1.0
33.	Willamette[2]	150	—	150	1.0
34.	Port Townsend[3]	100	—	100	0.6
35.	Temple-Inland[1]	50	—	50	0.3
36.	Cascades[1]	—	50	50	0.3
37.	Lincoln Pulp & Paper[2]	40	—	40	0.3

North American capacity (1991): 15.385 million metric tons
Capacity share of top five companies: 38.1%
Capacity share of top ten companies: 57.5%

Key to grades: 1—bleached softwood kraft; 2—bleached hardwood kraft; 3—unbleached softwood kraft; 4—bleached sulfite; 5—fluff pulp.

*Includes major new capacity expansion (which may not reach full production for at least a year).

a. Includes 25% of Celgar Pulp Co. (190,000 tpy total), which is owned 25% by Power Corp. and 50% by a Chinese government agency.

b. Includes 84.6% of Weldwood of Canada Ltd. (550,000 tpy), which inclues 50% stake in Cariboo Pulp & Paper (340,000 tpy).

c. Includes 45% stake in Donohue St-Félicien (300,000 tpy), owned 65% by Donohue Inc.

d. Includes 50% of Howe Sound Pulp & Paper Ltd. (340,000 tpy).

e. Includes 100% of Fraser Inc. and James Maclaren Industries Inc. and 50% of Northwood Pulp & Timber Ltd. (320,000 tpy); excludes 48%-owned MacMillan Bloedel Ltd., shown separately.

f. Includes 25% of Cariboo Pulp.

(c.i.f.) and the U.S. (delivered). Nordic producers then lowered their local currency prices—to DM1,250 in Germany.

In November 1990, Canadian producers again reduced their price for NBSK to $750 in Europe and the U.S. In response, Nordic producers reduced their local currency prices in Europe for NBSK—to DM1,150/ton in Germany. The local currency price for NBSK had dropped nearly 30% from its peak due to the combined effect of the reductions in the dollar price of pulp, the decline in value of the U.S. dollar, and the 11% decline in the dollar price. Unfortunately, the price reductions on NBSK only partly narrowed the gap with southern softwood and hardwood grades, which continued to erode. By the end of 1990, the price of southern softwood had dropped to about $600/metric ton in the U.S. domestic market, while southern hardwood had dropped to about $485.

After declining about 400,000 tons in 1989, world shipments of chemical paper-grade market pulp in 1990 dropped another 1 million tons to about 25.3 million tons. While part of this decline was due to customer inventory reduction (perhaps accounting for 200,000 tons), more of the decline was due to a sharp drop in demand from two Asian countries, Slinn told API's annual meeting. Japanese market pulp purchases dropped by 600,000 tons in 1990—a decline of about 20%. Demand from People's Rep. China also dropped sharply following the Tienanmen Square unrest in mid-1989. Chinese purchases of chemical paper-grade market pulp dropped from 520,000 tons in 1987 to 470,000 tons in 1988 and to only about 200,000 tons in 1989 but then recovered to slightly more than half the level of three year earlier in 1990.

U.S. domestic market pulp demand has also dropped sharply in the current market downturn. From a peak of 5.5 million metric tons in 1988, U.S. chemical paper-grade market pulp consumption declined 6.6% in 1989 and 5% in 1990 to 4.9 million tons. This decline probably reflects lower operating rates at integrated printing and writing papers mills, which respond by reducing outside pulp purchases. Other factors may also be at work, such as increased use of mechanical pulp, deinked fiber, and mineral fillers.

The dollar price of northern softwood continued to drop by monthly increments of almost $25/ton through most of 1991. The collapse in northern softwood prices was partly due to high inventories built up by Canadian producers in anticipation of a strike in British Columbia, which did not take place. Total inventories of chemical paper-grade market pulp reached a peak of 1.75 million metric tons at the end of August—with Canadian inventories hitting their highest level since 1977. By the beginning of October, the list price for northern softwood had dropped to $500/metric ton in major world markets—with spot prices down into the mid-$400 range in some export markets as Canadian mills began to "blow off" inventory.

The rapid drop in northern softwood through most of 1991 closed the large price gap with southern pine and hardwood pulp grades. After reducing inventories the previ-

OPERATING RATES FOR NORTH AMERICAN AND SCANDINAVIAN PAPER-GRADE MARKET PULP MILLS

Year	U.S.	Canada	Sweden	Finland	Norway	Total
1990	95%	84%	83%	78%	79%	87%
1989	96	95	96	98	96	96
1988	96	98	96	100	84	97
1987	100	98	90	96	100	97
1986	95	92	84	89	91	91
1985	86	86	81	84	89	86
1984	94	86	93	90	94	89
1983	89	88	87	82	90	85
1982	85	77	68	72	86	77
1981	90	89	79	89	83	97
1980	95	99	90	95	84	93
1979	88	93	82	94	n.a.	90
1978	92	83	70	71	n.a.	80
1977	87	80	62	58	n.a.	74

n.a. = Not available.
Source: Trade associations.

CHEMICAL PAPER-GRADE PULP SHIPMENTS BY NORTH AMERICAN AND SCANDINAVIAN PRODUCERS

(000 metric tons)

Year	U.S.	Canada	Sweden	Finland	Norway	Total	Brazil
1990	6,703	6,053	2,520	1,544	300	17,120	—
1989	6,495	—	2,728	1,749	313	18,254	—
1988	6,498	7,235	2,894	1,784	311	18,722	—
1987	6,227	7,260	2,864	1,770	342	18,461	1,359
1986	5,912	6,674	2,803	1,603	326	17,407	1,216
1985	5,183	6,058	3,036	1,632	299	16,208	1,256
1984	4,970	5,854	3,351	1,680	304	16,475	1,298
1983	4,816	6,219	3,122	1,743	202	16,102	1,259
1982	4,172	5,131	2,487	1,565	120	13,475	1,100
1981	4,248	6,024	2,816	1,839	134	15,061	1,060
1980	4,342	6,481	2,877	2,057	75	15,832	1,184
1979	3,781	6,078	3,335	2,030	112	15,336	765
1978	3,378	5,953	3,714	1,687	129	14,861	212
1977	3,030	5,327	3,167	1,304	172	13,000	55

Source: North American and Nordic trade associations.

ous year, eucalyptus producers in first-quarter 1991 were able to stabilize prices in Europe at close to ECU440/metric ton. Southern mixed hardwood supply also began to tighten in spring 1990, and prices began to stabilize. Southern pine continued to slip under pressure from northern softwood but declined at a slower rate. By October, the price of southern pine had dropped to about $425 and the price of southern mixed hardwood to about $400 in the U.S. domestic market.

This brought prices by late 1991 down close to variable cost levels of Canadian and Nordic producers. The combination of poor profitability and the need to reduce inventories was causing Canadian producers to take heavy downtime for the remainder of the year. In addition, some smaller, high-cost chemical pulp mills are being indefinitely shut down, such as Noranda Forest Products Inc.'s sulfite mill at Atholville, N.B., and Cascades Inc.'s small bleached softwood kraft line at Jonquière, Que. In addition, two BCTMP mills have shut down (Cascades-Port Cartier Inc. and Donohue Matane Inc.).

Meanwhile, demand for market pulp began to pick up in 1991 with an end to inventory liquidation in Europe and Japan and possibly some restocking in the Far East. North American and Nordic shipments of chemical paper-grade pulp through September were running 4% ahead of a year ago. Shipments by Canadian producers were up nearly 10% as customers apparently began to shift back to premium northern softwood now that it was not much more expensive than shorter fiber grades.

Total North American and Nordic shipments to Europe rose 9%, and deliveries to Japan jumped 10% for the first nine months of 1991. Shipments to Asia and Africa rocketed 37% as buyers seemed to be stocking up on low-priced pulp and substituting it more in fiber furnishes in place of wastepaper. The U.S. market, however, continued to lag, with shipments down 8.1% from a year ago.

The combination of rising shipments and increased downtime caused North American and Nordic producer inventories to drop sharply in September. The decline of 280,000 tons in September was the third largest monthly drop on record. In response to the changing market conditions, southern U.S. producers announced a $20/ton price increase for Nov. 1, which would take the domestic U.S. list price for southern pine to $445 and the price for mixed hardwood to $420. In addition, some Canadian suppliers also began to announce a $20/ton price increase on NBSK for Dec. 1, which would hike the list price to $520 in Europe and the U.S.

MARKET OUTLOOK

High pulp price levels and attractive return on investment during the 1987-89 period stimulated a wave of market pulp expansion activity. During the 1989-93 period, world paper-grade market pulp capacity (including mechanical grades) will expand from 33.8 million metric tpy to 38.7 million tpy—an increase of nearly 5 million metric tons, Rodney Young, president of Resource Information Systems Inc. (RISI), told *Pulp & Paper Week*'s First International Market Pulp Conference in Montreal, Que., in October 1991.

This would represent an average annual rate of capacity growth of 3.4%/year over this period, compared with a 2.6%/year rate of growth over the 1980-89 period.

Young projected that world market pulp shipments would rise about 5.8%/year over the 1991-93 period, with the strongest growth in demand occurring in Europe and the Far East. World market pulp demand is expected to jump 4.2% to 31.6 million tons in 1991 and reach 35.8 million tons in 1993. As a result, the shipments-to-capacity ratio for paper-grade pulp mills (including mechanical) would rise from 87% in 1991 to 93% by 1993, compared with an average of 97% for the mid-1986 to 1989 period.

Market pulp demand (including mechanical) from the Far East is expected to show the strongest growth, rising from 6.4 million tons in 1990 to 8.8 million tons by 1993—for an average growth rate of 11.2%/year. Demand for market pulp from Western Europe

NORTH AMERICAN AND SCANDINAVIAN CHEMICAL PAPER-GRADE PULP SHIPMENTS BY MAJOR WORLD MARKETS

(000 metric tons)

Year	U.S.	Western Europe[1]	Japan	Nordic countries	To other countries	Total
1990	4,510	6,700	1,589	939	340	17,120
1989	4,791	7,022	2,110	989	378	18,254
1988	5,122	6,916	1,941	996	3,656	18,722
1987	4,953	6,686	1,755	1,095	3,974	18,461
1986	4,831	6,563	1,618	1,018	3,349	17,407
1985	4,466	6,157	1,353	933	3,299	16,208
1984	4,682	6,181	1,241	969	2,975	16,408
1983	4,603	6,457	1,207	951	3,201	16,102
1982	3,811	5,551	980	773	2,360	13,475
1981	4,197	6,409	947	897	2,611	15,061
1980	4,327	6,536	1,244	991	2,734	15,832
1979	4,493	6,587	1,017	993	2,246	15,336
1978	4,193	6,520	973	878	2,297	14,861
1977	3,838	5,653	689	733	2,087	13,000

1. Including U.K.

Sources: North American and Nordic trade associations.

is expected to rise 4.7%/year, from 14 million tons in 1990 to 15.9 million tons by 1993, according to the RISI forecast. North American market pulp demand, however, is not expected to show much growth over this period, declining from 6.6 million tons in 1989 to 5.8 million tons in 1991 and then recovering to 6.6 million tons in 1993.

The large amount of new capacity that has to be absorbed from the last round of expansion activity will limit the recovery in prices and industry profitability over the next couple of years, said Young. According to RISI's projections, the price of northern softwood in the U.S. market will drop from an average of $567 in 1991 to $523 in 1992 and then improve to $686 in 1993 and reach a near-term peak of $764 in 1994, still well below the $840 peak reached in 1989. The dismal industry profit outlook is causing a number of major expansion projects proposed over the last several years to be postponed or canceled.

WAVE OF NEW CAPACITY

Nevertheless, substantial new capacity will be starting up over the next couple of years, mainly in North America and Latin America. In the U.S., Weyerhaeuser Co. started up a new bleached softwood kraft pulp line at its Columbus, Miss., mill in 1990 with market capacity of 360,000 tons. This was followed in 1991 by the startup of new lines at existing mills belonging to Union Camp Corp. at Eastover, S.C. (110,000 tpy softwood), and to Stone Savannah River Pulp & Paper Corp. at Port Wentworth, Ga. (240,000 softwood/hardwood). Alabama Pine Pulp Co. will also be starting up a new 445,000-tpy bleached softwood kraft pulp mill in Claiborne, Ala., in fall 1991.

In Canada, the largest expansions have included Daishowa Forest Products Ltd.'s new 340,00-tpy bleached hardwood pulp mill at Peace River, Alta., which began production in 1990. Despite the recent weakness in the pulp market, two major projects were recently approved for completion in 1993: Celgar Pulp Co.'s 200,000-tpy expansion of its bleached softwood kraft mill in Castlegar, B.C., and Alberta-Pacific's new 500,000-tpy bleached hardwood kraft pulp mill in Athabasca, Alta. Both projects had been delayed by environmental opposition.

In Latin America, new projects include Aracruz Celulose SA's 525,000-tpy expansion of its eucalyptus pulp mill in Brazil, which is the largest in the world. Several major expansions are also coming onstream in Chile, beginning with the 1991 startup of the new 240,000-tpy bleached eucalyptus mill, Celulosa Santa Fe (owned by Scott Paper Co./Shell/Citibank). These are being followed by two new radiata pine mills, the Celulosa Pacifico mill (a joint venture of CMPC of Chile and Simpson Paper Co.) and Arauco y Constitucion SA's new 350,000-tpy mill. In spring 1992, Bahia Sul is scheduled to start up a new eucalyptus pulp mill in Brazil with market capacity of 240,000 tpy.

In Europe, the largest project is Enso Gutzeit Oy's joint venture with the Soviet Union (Enocell) to expand its Uimaharju mill in Finland by close to 400,000 tpy. A number of major European market pulp expansions have been indefinitely postponed due to poor market conditions. Stora AB, for example, indefinitely postponed an expansion of its

NORTH AMERICAN AND SCANDINAVIAN PRODUCER INVENTORIES OF CHEMICAL PAPER-GRADE MARKET PULP

(000 metric tons)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1991p	1,501	1,602	1,586	1,561	1,579	1,626	1,658	1,749	1,469	—	—	—
1990p	1,422	1,475	1,392	1,388	1,442	1,397	1,699	1,649	1,484	1,461	1,447	1,367
1989	890	897	763	804	841	785	945	1,033	992	1,068	1,182	1,026
1988	915	900	797	815	767	671	798	845	772	797	852	673
1987	1,000	1,022	867	907	925	801	955	1,053	854	870	897	676
1986	1,330	1,306	1,131	1,024	1,080	943	1,014	1,030	894	890	1,018	847
1985	1,788	1,836	1,790	1,643	1,466	1,478	1,504	1,528	1,384	1,504	1,562	1,326
1984	1,303	1,084	914	1,003	1,034	1,039	1,247	1,349	1,309	1,490	1,635	1,616
1983	1,698	1,746	1,570	1,531	1,523	1,435	1,599	1,624	1,475	1,503	1,630	1,207
1982	1,579	1,690	1,767	1,744	1,840	1,878	1,876	1,923	1,748	1,840	1,809	1,603
1981	1,097	1,194	1,209	1,193	1,185	1,026	1,116	1,195	1,146	1,373	1,573	1,430
1980	745	741	747	754	801	745	813	916	830	933	1,094	949
1979	938	1,006	960	865	809	737	759	790	734	713	723	616
1978	2,119	2,016	1,857	1,776	1,612	1,288	1,188	1,193	1,069	1,046	1,038	903
1977	2,891	2,920	2,888	2,760	2,810	2,789	2,822	2,865	2,776	2,656	2,577	2,083
1976	2,121	2,260	2,373	2,408	2,474	2,588	2,638	2,749	2,720	2,809	2,882	2,824
1975	860	1,016	1,326	1,464	1,754	1,858	1,980	2,101	2,049	2,091	2,163	2,013
1974	628	628	625	595	565	532	545	557	538	550	567	611

p = Preliminary.
Source: North American and Nordic trade associations.

Celbi eucalyptus mill in northern Portugal, from 240,000 tpy to 600,000 tpy, which was scheduled for completion in late 1992. A couple of major pulp expansions in Finland have also been delayed, the first of which may be a new 450,000-tpy pulp line at Metsä-Botnia AB Oy's mill in Rauma. Södra Skogsägarna AB has shelved a 400,000-tpy expansion at its Mönsterås mill in Sweden, which was originally planned for the mid-1990s.

A number of major pulp mill projects remain in the planning stage in Latin America and could move ahead in the second half of the decade. These include Cenibra's plan to expand its Belo Oriente eucalyptus mill by 350,000 tpy and Riocell SA's plan to add about 300,000 tpy at its Guiaba mill. The giant mining company Companía Vale Rio Doce is involved in the Bahia Sul and Cenibra projects as well Norcell, a possible new greenfield pulp mill that would have a capacity of 500,000 tpy. Stora of Sweden and Arauco may build a 500,000-tpy pulp mill using a plantation being developed in southern Chile.

At least a half dozen major pulp expansions have also been discussed for Indonesia, but it is uncertain how many will actually be undertaken or how much of the production will be for market sale. According to one report, Indonesia's pulp production could increase from 1 million tons in 1991 to 3.8 million by the year 2000, with about 900,000 tons available for export.

COMPARATIVE PRODUCTION COSTS

The relative cost of making bleached softwood kraft market pulp in the world's major traditional producing regions is significantly affected by currency fluctuations. Fin-

COMPARATIVE NORTH AMERICAN AND NORDIC REGIONAL MANUFACTURING COSTS FOR BLEACHED SOFTWOOD KRAFT MARKET PULP IN 1989

(US$/metric ton)

	British Columbia Coast	British Columbia Interior	Eastern Canada	U.S. West	U.S. South	Finland	Sweden
Wood fiber	183	162	213	185	112	327	298
Chemicals	45	56	52	48	63	51	35
Energy	30	27	20	33	20	4	8
Labor	96	81	67	57	60	41	69
Other[1]	74	97	55	63	50	35	36
Total mill level costs	428	423	407	386	305	458	446
Corporate and sales expense	20	8	20	14	12	11	10
Delivery	53	82	53	67	51	42	45
Total delivered cost[2]	501	513	480	467	368	511	501

1. Includes materials, maintenance services, and mill administration net of byproduct revenues.
2. Before depreciation and interest expense.
Source: Forest Sector Advisory Council, "The Market Pulp Industry 1985-89."

HISTORICAL TOTAL DELIVERED MANUFACTURING COST FOR BLEACHED SOFTWOOD KRAFT AND COMPARATIVE RANKING AMONG REGIONS[1]

(Rank in parentheses)
(US$/metric ton)

Year	British Columbia Coast	British Columbia Interior	Eastern Canada	U.S. West	U.S. South	Finland	Sweden
1989	$501 (4)	$513 (6)	$480 (3)	$467 (2)	$368 (1)	$511 (5)	$501 (4)
1988	433 (3)	451 (5)	434 (4)	390 (2)	338 (1)	498 (6)	498 (6)
1987	385 (5)	379 (3)	382 (4)	360 (2)	315 (1)	469 (6)	469 (6)
1986	354 (3)	346 (2)	355 (4)	372 (5)	325 (1)	408 (7)	406 (6)
1985	386 (6)	349 (2)	373 (4)	379 (5)	361 (3)	349 (2)	330 (1)
1984	427 (7)	405 (6)	376 (3)	382 (4)	385 (5)	341 (2)	314 (1)

1. Before depreciation and interest expense.
Source: Forest Sector Advisory Council, "The Market Pulp Industry 1985-89."

land and Sweden, for example, moved from being the lowest-cost producers among seven regions in North America and Scandinavia in 1984 to the most expensive in 1986, in part because of exchange rates. They still have not recovered their prime economic position, according to the latest study prepared by Price Waterhouse for the Forest Sector Advisory Council (FSAC), a Canadian government/industry group. On the other hand, the U.S. South levered itself up from fifth place in 1984 and since 1986 has clung to its position as lowest-cost producer. Other factors that determine relative pulp costs include fiber, chemicals, labor, and delivery expenses.

The 1989 delivered costs (excluding interest and depreciation) for the seven regions were as follows: U.S. South, $368/metric ton; U.S. West, $467; eastern Canada, $480; British Columbia Coast, $501; Sweden, $501; Finland, $511; and British Columbia Interior, $513. The U.S. South has shown the most dramatic improvement since 1984. The region has benefitted from an increasingly competitive fiber cost over the years, to the point where southern fiber costs are only about one-third of those in Finland, for example. Delivered pulp costs per ton in the South rose 9% in 1989 from the previous year but were still 4% less than in 1984, according to the study.

The U.S. West has been the second most economic region since 1987, but its delivered costs took a 20% hike in 1989—the largest increase in local currency for any region—due primarily to a 50% jump in fiber expenses. On the other hand, the region has benefitted from a favorable exchange rate, lower oil (and hence energy) costs, and the most capital investment per ton of pulp from 1985 to 1988 among the regions surveyed.

The British Columbia Interior was among the most costly regions back in 1984 but managed the following year to improve its position considerably. Since then, it has slipped back to the end of the pack, hurt by escalating labor, maintenance, and fiber costs. The British Columbia Coast's rank has not shown any definite trend over the past several years. Delivered pulp prices rose 11% in 1989 in Canadian dollars, again reflecting woodfiber cost performance.

Sweden and Finland have not exhibited large annual growth rates in delivered pulp prices over the years in terms of local currency, but their competitive position has been seriously eroded by the decline in value of the U.S. and Canadian dollars compared with the Swedish krona and Finnish markka. However, FSAC noted that currency changes and tighter cost control in 1989 improved the Scandinavian position.

Fiber costs among the seven regions in the survey were highest in Finland and Sweden in 1989; apart from the U.S. South, however, the relative advantage is not as marked as in the previous year. Fiber costs in the U.S. West jumped due to high demand and scarcity. Prices also rose on the British Columbia Coast because of the strong pulp market and a tightening fiber supply situation. In the Interior, chip prices rose because the government established a minimum price higher than previous pricing policy would have effected, FSAC said.

Energy costs are a minimal fraction of pulp production expenses in Finland and Sweden—which have invested extensively in cogeneration—but are much higher in the U.S. West and British Columbia. Finland is nearly twice as energy efficient as British Columbia (which has the highest energy consumption), and its mills are completely self-reliant for energy consumed, according to the study. Sweden buys about one-third of its electric power needs, Canada buys about half, and the U.S. West buys somewhat more than three-quarters.

The British Columbia Coast leads the pack in labor costs. In U.S. dollars, this expense is more than twice as much on the Coast as in Finland, and in local currencies it represents 19% of expenses per ton delivered on the Coast vs 8% in Finland. Delivery costs remain at the top in the British Columbia Interior because of its distance from offshore markets and the relatively high cost of transport by rail.

Capital investment per ton of pulp from 1985-89 was highest on the Coast and lowest in eastern Canada. Pulping facilities in the U.S. South were newest, with the average date of construction being 1982, followed by Finland and Sweden (1980-81) and the remaining regions (1973-76).

WORLD DEMAND FOR CHEMICAL PAPER-GRADE MARKET PULP

(000 tons)

Year	Total world demand	From North American/Nordic countries	From nontraditional countries	% from North American/Nordic countries
1989	26,285	18,260	8,025	69.5%
1988	26,720	18,705	8,015	70.1
1987	26,395	18,465	7,930	70.0
1986	25,150	17,405	7,745	69.2
1985	23,450	16,095	7,355	68.6
1984	22,515	15,900	6,615	70.6
1983	22,320	15,895	6,425	71.2
1982	18,985	13,335	5,650	70.2
1981	19,970	14,490	5,480	72.6
1980	21,420	15,780	5,640	73.7
1979	20,505	15,310	5,195	74.7
1978	19,400	14,805	4,595	76.3
1977	17,060	12,995	4,065	76.2
1976	17,075	12,610	4,465	73.9
1975	14,900	11,290	3,610	75.8

1990 WOODPULP EXPORTS FROM MAJOR PRODUCING COUNTRIES

(000 metric tons)

	Exporters					
Major Importers	**U.S.**	**Canada**	**Sweden**	**Finland**	**Norway**	**Brazil**
Austria	33	63	43	32	3	7
Belgium	71	240	117	25	17	29
Czechoslovakia	7	3	13	15	—	—
Denmark	5	—	56	16	23	4
Finland	—	7	27	—	12	—
France	300	236	259	134	69	61
Germany, Dem. Rep.	1	5	23	44	—	2
Germany, Fed. Rep.	534	654	899	411	157	91
Greece	40	19	24	18	1	—
Hungary	—	—	14	—	—	—
Ireland	3	15	2	2	—	—
Italy	409	378	287	112	33	40
Netherlands	115	146	170	54	51	12
Norway	—	—	62	1	—	—
Poland	21	17	9	3	2	—
Portugal	18	—	3	11	1	—
Spain	125	31	7	13	5	9
Sweden	20	14	—	3	51	14
Switzerland	52	55	77	42	8	6
U.K.	246	317	241	252	96	77
U.S.S.R.	13	19	1	89	22	—
Yugoslavia	10	4	37	4	4	3
Other Europe	9	2	63	—	5	3
Total Europe	**2,031**	**2,226**	**2,434**	**1,280**	**560**	**358**
Canada	207	—	7	—	—	3
U.S.	—	3,718	31	8	—	331
Total North America	**207**	**3,718**	**38**	**8**	—	**334**
Brazil	7	18	—	—	—	—
Colombia	13	2	—	2	—	8
Mexico	270	44	—	—	—	—
Venezuela	130	39	—	—	—	3
Other Latin America	28	13	—	—	—	9
Total Latin America	**448**	**116**	—	**2**	—	**19**
China, People's Rep.	82	196	11	7	1	2
Hong Kong	9	14	—	—	—	—
India	89	85	13	7	—	1
Indonesia	89	36	16	3	1	1
Iran	—	10	8	6	3	—
Iraq	27	—	1	—	—	—
Israel	28	12	10	18	4	—
Japan	1,036	790	83	30	—	207
Korea, Rep.	455	192	23	14	—	33
Pakistan	20	1	—	—	—	—
Philippines	24	6	—	—	—	—
Saudi Arabia	41	—	—	—	—	—
Singapore	1	7	—	—	—	2
Taiwan	224	74	38	8	—	8
Thailand	25	39	5	—	—	—
Turkey	39	—	32	7	—	—
Other Asia	14	9	9	6	7	2
Total Asia	**2,202**	**1,471**	**248**	**107**	**16**	**257**
Australia	37	68	13	13	—	4
New Zealand	10	—	—	—	—	—
Total Australasia	**46**	**68**	**13**	**13**	—	**4**
Algeria	48	—	2	—	—	—
Egypt	40	—	1	2	—	—
Morocco	2	—	17	1	4	—
South Africa	25	1	—	—	—	1
Other Africa	4	2	17	3	2	—
Total Africa	**118**	**4**	**36**	**5**	**6**	**1**
WORLD TOTAL	5,052	7,602	2,769	1,415	582	973

Note: This table reports total pulp exports, not just market pulp. Also, Brazil's exports here are hardwood only and Finland's are chemical pulp only.
Source: *Pulp & Paper International*, "Market Pulp Survey," October 1991.

MECHANICAL PULPS

Mechanical pulps are produced by either the groundwood, refiner mechanical, or thermomechanical pulping processes. BCTMP is produced by a newer process that is replacing the earlier methods for making mechanical market pulp. Sweden can lay claim to the first BCTMP mill, built in the late 1970s, but Canada has shown the most dramatic growth for this process because of favorable wood and energy costs, government financial incentives, and willing entrepreneurs. Quesnel River Pulp Co. started up the first Canadian BCTMP mill in British Columbia in 1982.

The BCTMP process appeals to potential market pulp producers because of its relatively low capital costs and wood consumption. A greenfield BCTMP mill can be built for less than half the cost of a new kraft market pulp mill (on a per-daily-ton basis), and a ton of BCTMP can be produced with less than half the wood required to make a ton of bleached softwood kraft pulp. Because of its lower manufacturing costs, BCTMP producers have tried to sell their pulp at about 75% to 80% of the price of northern bleached softwood kraft.

BCTMP mills initially concentrated primarily on higher-freeness softwood pulps used in tissue/towel applications. But new capacity is aimed at production of lower-freeness pulp, particularly aspen, for use in printing/writing papers—the largest potential end-use market. BCTMP is superior in bulk and opacity to kraft pulp and has good absorbency, but it does have some drawbacks, being lower in tensile and tear strength. The new aspen BCTMP can be bleached to between 85 and 87 ISO, while spruce pulps can be bleached to between 80 and 82. These levels are close to bleached kraft pulp and are adequate for many paper grades, particularly if coatings and fillers are used (which can also improve the economics of using BCTMP fiber). One producer expects greater acceptance as U.S. white paper producers catch up with Europe and switch over to neutral/alkaline sizing. That allows producers to raise filler content to at least 20% to make up for BCTMP paper's deficiencies in smoothness and brightness.

In the U.S., BCTMP has run up against established printing/writing paper grade classifications that limit mechanical pulp content to 10% in free-sheet grades. These classifications were designed to prevent potential brightness reversion in mechanical pulps, but the amount of such loss in

MAJOR MARKET PULP PRODUCERS OUTSIDE NORTH AMERICA*

(000 metric tpy)

Company	Capacity
Aracruz (Brazil)	1,040**
Södra Skogsägarna (Sweden)	1,000
Mo och Domsjö (Sweden)	680
Portucel (Portugal)	585
Metsä Botnia (Finland)	560
Cel. Arauco y Constitución (Chile)	530**
Veitsiluoto (Finland)	470
ENCE (Spain)	460
Cel. du Rhone et d'Aquitane (France)	440
CMPC (Chile)	355**[1]
Stora (Sweden)	355[2]
Cenibra (Brazil)	350
Riocell (Brazil)	300

*Chemical paper-grade market pulp capacity only.

**Reflects major expansion, which may not reach design capacity until 1992.

1. Includes 50% stake in Cel. Pacifico.
2. Includes 70% interest in Celbi mill in Portugal.

WORLD MARKET PULP SHIPMENTS BY GRADE

(000 metric tons)

Year	Chemical paper-grade	Bleached softwood sulfate	Bleached hardwood sulfate	Unbleached sulfate	Bleached sulfite	Unbleached sulfite	Mechanical	Total
1989	26,285	13,275	9,810	1,530	1,575	95	2,130	28,415
1988	26,720	13,500	9,695	1,655	1,740	130	2,030	28,750
1987	26,395	13,375	9,340	1,745	1,795	140	1,785	28,180
1986	25,150	12,800	8,790	1,675	1,755	130	1,700	26,850
1985	23,450	11,795	8,085	1,650	1,760	160	1,625	25,075
1984	22,515	11,210	7,790	1,605	1,700	210	1,640	24,155
1983	22,320	11,130	7,485	1,815	1,695	195	1,450	23,770
1982	18,985	9,535	6,230	1,715	1,300	205	1,280	29,265
1981	20,470	10,380	6,245	1,845	1,710	290	n.a.	n.a.
1980	21,420	10,680	6,370	2,025	1,935	410	n.a.	n.a.

n.a. = Not available.

Source: Canadian Pulp & Paper Assn.

BCTMP-containing papers might be acceptable for many applications. New standards that would permit more mechanical fiber content in free-sheet paper to accommodate greater use of wastepaper may also help BCTMP. Other factors that are restraining BCTMP growth include long trials at paper mills and equipment and process changes necessary for paper mills to handle the new pulp. In addition, tumbling bleached kraft pulp prices have limited its economic attractiveness.

Overall, aspen BCTMP sales are going strong—even if prices are not too good, but softwood BCTMP producers appear to be suffering, with outages and outright closures occurring. Industry operating rates in Canada might have been as low as 75% to 80% in 1991, even though a number of mills were running full out. This was attributed to the fact that Cascades Port Cartier Inc. was essentially out of the market because of its concentration on the fluff BCTMP business. Cascades Port Cartier permanently closed its money-losing BCTMP mill in Port Cartier, Que., in fall 1991. Cascades Inc., a 50% owner of the mill, had sought financial help from the province to cover losses at the mill through 1994. But those negotiations proved unsuccessful, and Cascades withdrew from the project. Quebec's forestry agency, Rexfor, owned the other 50% share in the 180,000-metric-tpy fluff BCTMP mill.

Rexfor is involved in another troubled project—Donohue Matane Inc., a joint venture with Donohue Inc. in Matane, Que. The first line at Donohue Matane's 190,000-metric-tpy market BCTMP mill started up late in 1990, and the second line began running early the following year. But the mill was forced to take some time off in mid-1991 to reduce inventories. The C$240-million facility was designed for softwood BCTMP production, but a pretty significant fraction of capacity could be swung over to aspen BCTMP production. The firm is also considering some type of paper or board machine for the mill (excluding newsprint) that could sop up BCTMP.

Slave Lake Pulp Corp.'s 110,000-metric-tpy mill in Alberta went online in December 1990. The $182-million mill will supply high-grade printing and writing markets, with about a quarter of production going to North America and the rest split between Europe and the Far East. Slave Lake is a joint venture between Alberta Energy Co. Ltd. and MoDo.

Louisiana-Pacific Canada Ltd.'s new Chetwynd, B.C., mill started up in 1991. The C$150-million facility has capacity for 157,500 metric tpy of aspen BCTMP for the printing/writing papers market.

Tembec Inc. expected a September 1991 startup of its second softwood/aspen Temcell line in Temiscaming, Que. Some BCTMP from the mill will go to Tembec's Temboard & Co. Ltd. boxboard machine, but a contact said the new 150,000-metric-tpy Temcell II line would raise market BCTMP capacity to 200,000 tpy.

Millar Western Pulp Ltd. is

WORLD CHEMICAL PAPER-GRADE MARKET PULP CAPACITY[1]

(000 metric tons)

	1988	1989	1990	1991e	1992e
Canada	7,390	7,445	7,645	8,030	8,095
U.S.	6,760	6,890	7,070	7,465	8,035
Finland	1,815	1,820	1,980	1,965	1,900
Norway	350	345	370	370	390
Sweden	2,990	2,955	3,070	3,060	3,075
North America/Nordic	19,305	19,455	20,135	20,890	21,495
Austria	390	380	295	295	295
Belgium	225	235	240	250	205
France	935	975	1,030	1,030	1,070
West Germany	130	125	125	90	70
Italy	50	50	50	50	50
Portugal	1,265	1,295	1,300	1,340	1,240
Spain	725	755	775	780	790
Switzerland	125	125	125	135	135
Western Europe	3,845	3,940	3,940	3,965	3,850
Argentina	235	275	280	280	280
Brazil	1,465	1,580	1,630	1,995	2,240
Chile	545	595	550	765	1,240
Mexico	205	205	130	125	125
Latin America	2,450	2,655	2,590	3,165	3,885
Japan	755	755	795	890	890
Australia	35	5	5	5	5
New Zealand	285	310	355	390	390
Oceania	320	315	360	395	395
Indonesia	15	90	150	165	165
Morocco	110	110	115	130	130
South Africa	160	160	160	160	160
Rep. Korea	155	155	155	195	195
Swaziland	180	180	180	185	185
Taiwan	350	380	400	420	420
Thailand	—	30	45	70	70
Asia/Africa	970	1,105	1,205	1,325	1,325
Total world[2]	27,645	28,225	29,025	30,630	31,840

e = Estimate.

[1] Practical maximum: 100% of nominal capacity for North America, Nordic, Latin America; 97% for Western Europe and Japan; and 95% for Oceania, Asia, and Africa.

[2] Excludes Eastern Europe and People's Rep. China.

Source: North American and Nordic pulp and paper associations.

moving ahead on a 240,000-metric-tpy aspen BCTMP facility in Meadow Lake, Sask., due online in spring 1992. This will more than double 210,000-metric-tpy BCTMP capacity already in place at Whitecourt, Alta.

Two other projects on the drawing board in Canada could become casualties of the market's weakness. Shin Ho Canada Ltd. said it may decide to abandon its long drawn-out attempt to put up a C$180-million, 160,000-metric-tpy aspen BCTMP mill in Thunder Bay, Ont. Shin Ho said its head office in Seoul, Rep. Korea, was "reviewing everything," including some proposals to invest in other firms' existing BCTMP mills. In addition, the Vanderhoof Pulp & Paper Ltd. mill proposed for British Columbia was put on hold because of uncertainties about the site and about supplying power to the facility.

According to Canadian Pulp & Paper Assn. statistics, Canadian shipments of mechanical market pulp through July were running at a rate of 655,000 metric tons, up 12% from a year earlier. However, shipments to the U.S. were down 9% to 171,000 tons.

Industry sources estimated that world market BCTMP capacity by year-end 1991 would reach about 2 to 2.5 million metric tons, with North America accounting for about 1.5 to 2 million tons. New Zealand and Scandinavia are the other major producing regions.

Softwood capacity may represent about 2 million tons, leaving 0.5 million tons for aspen, estimated one contact in the business. The principal applications for softwood BCTMP are tissue, toweling, fluff, and newsprint and mechanical printing papers. Hardwood BCTMP funnels primarily into the printing/writing papers market. This is the fastest-growing outlet for BCTMP—with one producer estimating growth of 15% to 20% from 1990 to 1991.

Demand for aspen BCTMP in the Far East in the printing/writing sector reportedly has been good for a number of years and is growing. Europe is increasingly accepting the grade as it becomes more available and a steady supply becomes more certain; the pulp's chlorine-free characteristic is also helping sales in the region. And one producer noted that some European mechanical and stone groundwood facilities have been shut down, increasing the demand for BCTMP. North America has been slow to accept the pulp, in part because of competition from low-priced mixed hardwood during the downturn in the pulp market, said one supplier.

Millar Western Industries Ltd. is estimated to send 100,000 tpy or more to Scott Paper Co., and Quesnel River Pulp ships perhaps 30,000 to 40,000 tpy to Procter & Gamble Co.—both for the tissue/toweling market. But BCTMP is

MAJOR WORLD CHEMICAL PAPER-GRADE MARKET PULP EXPANSIONS

Company	Location	Capacity (000 metric tpy)	Startup date
CANADA			
Champion (Weldwood)	Hinton, Alta.	110 BSK	1990
James Maclaren	Thurso, Que.	70 BHK	1990
Canadian Pacific Forest Products	Dryden, Ont.	(110 BSK)	1990
Daishowa Forest Products	Peace River, Alta.	340 BHK/BSK	1990-91
Howe Sound Pulp (Canfor/Oji)	Port Mellon, B.C.	100 BSK	1990-91
Malette Kraft Pulp & Power	Smooth Rock, Ont.	70 BSK/BHK	1992
Celgar Pulp	Castlegar, B.C.	200 BSK	1993-94
Alberta-Pacific	Athabasca, Alta.	500 BHK/BSK	1993-94
U.S.			
Bowater	Calhoun, Tenn.	80 BHK	1990-91
Weyerhaeuser	Columbus, Miss.	360 BSK	1990-91
Champion International	Quinnesec, Mich.	(100 BHK)	1990
Union Camp	Eastover, S.C.	110 BSK	1991-92
Stone Savannah River	Port Wentworth, Ga.	240 BSK/BHK	1991-92
Alabama Pine	Claiborne, Ala.	445 BSK	1991-92
ITT Rayonier	Jesup, Ga.	80 BSK	1992-93
EUROPE			
Soporcel	Lavos, Portugal	(170 BHK)	1991
Cel. du Rhône et d'Aquitaine	St. Gaudens, France	70 BHK/BSK	1992
	Tarascon, France	40 BSK	1992
Enocell (Enso/USSR)	Uimaharju, Finland	400 BHK/BSK	1993-94
LATIN AMERICA			
Aracruz	Espirito Santo, Brazil	525 BHK	1991-92
Cel Santa Fe (Scott/Shell)	Nacimiento, Chile	240 BHK	1991-92
Cel Pacifico (CMPC/Simpson)	Mininco, Chile	330 BHK	1991-92
Cel. Arauco	Arauco, Chile	350 BSK	1991-92
Chihuahua	Anahuac, Mexico	(80 BSK)	1991
Bahiasul	Mucuri, Brazil	240 BHK	1992-93
Cenibra	Belo Oriente, Brazil	350 BHK	n.a.
Riocell	Guiaba, Brazil	310 BHK	n.a.
Norcell	Bahia, Brazil	420 BHK	n.a.
ASIA			
Tasman	Kawerau, New Zealand	55 BSK	1991
Indorayon	Porsea, Indonesia	60 BSK	1992

BSK = bleached softwood kraft, BHK = bleached hardwood kraft.
( ) = Indicates capacity withdrawal due to a new paper machine.
n.a. = Not available (project proposed but not approved).

having a tough time in fluff markets because of competition from bleached softwood kraft, noted one contact—hence the troubles at Cascades.

Aspen BCTMP (85 brightness) was selling in the low-$400 range in the U.S. and Far East in third-quarter 1991. In Europe it was fetching about $425 to $450. Softwood BCTMP (80 brightness) prices were said to be in the low $400s in the U.S., the Far East, and Europe. Before prices could go considerably lower in the fourth quarter, they were expected to run into a natural barrier. "There is not much room from the producers' side to go down [in price] before we see serious downtime taken," noted one supplier.

DISSOLVING PULP

Dissolving pulps are used in producing man-made fibers (rayon and acetate), films (cellophane), plastics (cellulose acetates), and chemicals (methyl cellulose and carboxymethyl cellulose). Also referred to as chemical cellulose, these pulps are highly purified grades composed of 95% to 99% cellulose. Most dissolving pulps are made from softwood, although some hardwood is used. They can be made via the prehydrolyzed sulfate process or the modified acid sulfite process. Dissolving pulps differ in purity and reactivity. Sulfite dissolving pulps are the most reactive pulps, suitable for producing rayon and cellophane. Prehydrolyzed sulfate pulps generally produce a stronger rayon fiber for applications such as high-wet-modulus textile rayon and high-tenacity rayon tire cords.

Chemical cellulose products can be converted by four different processes. Viscose products dominate, accounting for about 80% of the dissolving pulp shipped. Three-quarters of viscose production consists of rayon for textiles and tire cord, with the remainder going into cellophane and products such as sausage casings and sponges. Acetate products are the second-largest group and include textiles, cigarette filters, rigid packaging, photographic film, and high-quality plastics. Cellulose ethers are increasingly being used in pharmaceuticals, cosmetics, detergents, food products, superabsorbents, and additives for oil-well drilling muds. Finally, cellulose nitrates are used in explosives, lacquers, printing inks, and rocket fuels.

Competition from cheaper synthetic fibers and films has depressed dissolving pulp demand. Rayon staple, for example, has suffered from polyester's success, and cellophane has lost ground to plastic films, such as oriented polypropylene. High-performance rayons (such as high-wet-modulus staple, which offers cotton-like quality and high durability), cellulose ethers, and nontextile acetate (such as cigarette filter tow, for which demand is growing strongly in countries like People's Rep. China) have performed better in the marketplace.

The rayon industry has been moving out of the industrialized regions of the world. In the U.S. the closure of Avtex Fibers Inc.'s plant in Virginia in 1989 took the nation's largest rayon producer off the market. That left just two U.S. producers, BASF Fibers Div. and Courtaulds North America Co. And in 1988, Courtaulds shut down the last cellophane manufacturing plant in Canada.

The annual United Nations/Food & Agriculture Organization capacity survey indicated that world dissolving pulp capacity fell off from about 6.2 million tons in 1985 to 5.3 million tons in 1990. Production of dissolving pulp in the U.S. plunged from a high of 1.6 million metric tons in the mid-1970s to a trough of 988,000 tons in the 1982 recession and then climbed back up again. In 1990, U.S. shipments reached 1.191 million metric tons, off 4.7% from 1989. Suppliers agreed that there was generally a bit too much capacity for consumption worldwide.

North American dissolving pulp producers describe their business in terms ranging from "okay" to "grim." The recession's impact on rayon demand, combined with the continued absence of major buyers such as the Soviets, are factors that have weakened the market. The Soviets withdrew

WORLD CHEMICAL PAPER-GRADE MARKET PULP SHIPMENTS BY DESTINATION

(000 metric tons)

Year	U.S.	Canada	Western Europe	Nordic	Eastern Europe	Latin America	Japan	Asia/ Africa*	Oceania	Total
1989	5,150	940	11,045	1,025	330	1,335	3,225	2,940	295	26,285
1988	5,515	965	10,995	1,030	310	1,555	2,950	3,090	310	26,720
1987	5,310	970	10,540	1,135	295	1,785	2,780	3,220	360	26,395
1986	5,130	890	10,310	1,130	285	1,705	2,595	2,825	280	25,150
1985	4,700	845	9,445	1,000	210	1,620	2,395	3,010	225	23,450
1984	4,835	845	9,280	995	230	1,275	2,290	2,520	245	22,515
1983	4,720	735	9,145	980	255	1,015	2,260	2,955	255	22,320
1982	3,940	605	8,120	820	260	935	1,950	2,080	275	18,985
1981	4,325	750	9,010	930	380	865	1,800	2,095	315	20,470
1980	4,420	735	9,145	1,025	470	1,190	2,330	1,770	335	21,420

*Includes People's Rep. China (which purchased 470,000 metric tons from North American and Nordic suppliers in 1988—down from 520,000 tons in 1987 and the peak of 600,000 tons in 1983).

from the market because of their lack of hard currency. Back in 1989, the region imported nearly 28,000 tons of dissolving pulp from the U.S. Indian imports have also dropped off significantly, reportedly because of currency fluctuations and a lack of hard currency. In all of 1990, the country imported almost 54,000 tons from the U.S., but in first-half 1991, those imports were less than 10,000 tons. High production costs, growing environmental pressures on many older sulfite mills that are not economical to clean up, and more profitable opportunities in integrated paper pulp production have also put a damper on the market.

While the recession stagnated the core dissolving pulp market, eating away at demand for rayon and consumer products, specialty pulps are somewhat less vulnerable to economic cycles and are the industry's current stars. These pulps are used in the ethers market, for example, to make products such as toothpaste and eyeglasses. "These products are regularly purchased," said a pulp producer. "They are not specialty items that you only buy when you have available funds." Another outlet for dissolving pulp—microcrystalline cellulose (MCC), which is used as a binder in pharmaceutical tablets—is doing quite well. FMC Corp. has announced expansions at its Newark, Del., and Cork, Ireland, plants, and other MCC producers worldwide are also considering expansions.

Among the more mainstream dissolving pulp sectors, a number of major pulp consumers are expanding their ca-

HISTORIC PRICES, 1950-69, FOR NORTH AMERICAN MARKET PULP

Average annual prices for bleached kraft pulp, delivered in U.S. domestic market (US$/short ton)

Year	Northern bleached softwood kraft	Southern bleached softwood kraft	Northern bleached hardwood kraft	Southern bleached hardwood kraft
1969	$145	$133	$131	$129
1968	145	123	118	115
1967	150	129	130	124
1966	148	135	136	129
1965	150	144	135	133
1964	146	141	128	130
1963	139	132	130	124
1962	143	129	134	124
1961	145	135	135	130
1960	156	151	151	146
1959	157	157	152	152
1958	157	157	152	152
1957	153	155	151	150
1956	151	154	149	149
1955	146	149	144	144
1954	142	145	140	140
1953	142	145	140	140
1952	142	145	—	—
1951	139	—	—	—
1950	120	—	—	—

U.S. DOMESTIC PRICES FOR BLEACHED KRAFT MARKET PULP

($/metric ton, delivered)

Year	Northern bleached softwood kraft	Southern bleached softwood kraft	Northern bleached hardwood kraft	Southern bleached hardwood kraft
1991				
3Q	$535*	$465*	$435*	$420*
2Q	600*	515*	465*	435*
1Q	665*	565*	475*	455*
1990				
4Q	765*	620*	570*	500*
3Q	800*	640*	660*	570*
2Q	830*	650*	680*	620*
1Q	830*	720*	745*	680*
1989				
4Q	830	800*	745/765*	700*
3Q	830	800*	745/765	735*
2Q	830	800	745/765	735
1Q	800	780	745	735
1988				
4Q	760	735/740	705	685/695
3Q	735	705/715	705	685/695
2Q	700	670	665	650
1Q	655	630	620	610
1987				
4Q	610	585	575	565
3Q	575	550	540	530
2Q	575	550	540	530
1Q	550	520	510	500
1986				
4Q	480	490	470	460
3Q	480	450	425	420
2Q	450	420	385	380
1Q	410	360/385	340/360	320/345
Year end				
1985	400*	360	330/360*	320*
1984	510*	475	460/470*	450*
1983	440	415/425*	410/420	390/400
1982	440	385*	364/380*	353*
1981	530/565	495	468/490*	424*
1980	530	507	490	480
1979	460	400	433	420
1978	375	353	342	330
1977	342*	287	276*	260*
1976	410	353	331	310
1975	410	353	369	353
1974	386	386	369	353
1973	259	246	248	213
1972	179	180	149	150
1971	165*	160	149*	148*
1970	188	180	171	170

*Indicates some discounting from price levels shown above.

pacity, including Hoechst Celanese Corp., which will hike cellulose acetate tow and flake capacity worldwide; the Rhône-Poulenc/Eastman Chemical Products Inc. cellulose acetate joint venture; and major staple fiber expansions in Southeast Asia. As mentioned, acetate cigarette filter tow is doing well, particularly in offshore markets such as People's Rep. China. However, demand growth for other products has generally lagged mills' capacity expansions because of the recession. For example, some major dissolving pulp users in the Far East may have increased their purchases, but this did not have much impact on pulp demand on a worldwide basis because of the soft end-use markets. "If they are marketing the same rayon staple back in the U.S., another local producer may be marketing less because his

U.S. DOMESTIC PRICES FOR OTHER PAPER-GRADE MARKET PULPS

($/metric ton, delivered)

Year	Bleached sulfite	Unbleached softwood kraft	Bleached CTMP softwood (80 GE bright)	Bleached eucalyptus
1991				
4Q	$490*	$540*	$390*	$480*
3Q	515*	550*	410*	500*
2Q	575*	560*	450*	510*
1Q	625*	580*	470*	520*
1990				
4Q	690*	600*	520	550
3Q	690*	600*	540*	680
2Q	720*	600*	560*	700*
1Q	750*	600*	580*	760*
1989				
4Q	790	625*	640*	760
3Q	790	650/665*	640*	780
2Q	790	650/665*	640	780
1Q	770	650/665*		760
1988				
4Q	730	650/665	625	720
3Q	715	650/665	600	720
2Q	660/670	635/665	560	—
1Q	610/620	590/620	525	—
1987				
4Q	565/575	545/575	485	—
3Q	530/540	505/540	440	—
2Q	530/540	505/540	440	—
1Q	505	475/510	420	—
1986				
4Q	470	440/480	385	—
3Q	440	420/440	385	—
2Q	410	405	360	—
1Q	355	360	330	—
Year end				
1985	355	360	360	—
1984	455	430	415	—
1983	420/430*	370	365	—
1982	420*	360*	—	—
1981	520	490	—	—
1980	520	490	—	—
1979	450	422	—	—
1978	358	310	—	—
1977	320*	280*	—	—
1976	400	380	—	—

*Indicates some discounting from price levels shown.

U.S. DOMESTIC PRICES FOR SPECIALTY PULPS

($/metric ton, delivered)

Year	Fluff (untreated bleached softwood kraft in rolls)	Dissolving (sulfite viscose staple grade, 91 to 92 alpha)
1991		
4Q	$625*	$700/730*
3Q	650*	700/730*
2Q	680*	720/750*
1Q	710*	720/750*
1990		
4Q	750*	730/750*
3Q	800*	740/760*
2Q	800*	800/830*
1Q	830*	880/900*
1989		
4Q	830	880/900
3Q	830	880/900
2Q	820/830	850/870
1Q	800	810/830
1988		
4Q	760	800/810
3Q	735	760/780
2Q	690/700	710/720
1Q	660	660/670
1987		
4Q	615	615/635
3Q	580	580/600
2Q	580	540/560
1Q	560	550
1986		
4Q	540	510
3Q	500	510
2Q	475	500
1Q	440	500
Year end		
1985	440	500
1984	535/555	530
1983	470*	525
1982	485*	530
1981	572/607	620
1980	550	670
1979	475	530
1978	—	430
1977	—	455
1976	—	468
1975	—	425

*Indicates some discounting from price levels shown.

NORTH AMERICAN EXPORT PRICES FOR BLEACHED KRAFT MARKET PULP

(US$/metric ton, c.i.f. northern Europe)

Year	Northern bleached softwood kraft	Southern bleached softwood kraft	Northern bleached hardwood kraft	Southern bleached hardwood kraft
1991				
3Q	$540*	$480*	$480*	$465
2Q	615*	550*	500	480*
1Q	690*	600*	510*	495*
1990				
4Q	765*	635*	585	520*
3Q	800*	650*	640*	580*
2Q	840*	650*	670*	620*
1Q	840	700*	790*	680*
1989				
4Q	840	810	790	780*
3Q	840	810	790	780*
2Q	840	810	790	780
1Q	810	780	770	760
1988				
4Q	760	730	720	710
3Q	760	730	720	710
2Q	725	695	690	680
1Q	680	655	650	640
1987				
4Q	635	610	600	595
3Q	610	585	575	570
2Q	585	560	550	545
1Q	550	525	515	510
1986				
4Q	520	490	475	470
3Q	480	460	445	440
2Q	450	420	395	390
1Q	415	380	350	345
Year end				
1985	380/390*	355*	330	325*
1984	485*	465*	—	430*
1983	430*	400	—	385*
1982	420*	390*	—	360*
1981	545	500*	—	455*
1980	545	530	—	505
1979	465/475	450	—	435
1978	380	360	—	350
1977	350*	330/340*	—	300/320*
1976	415*	410*	—	405*
1975	415	410	—	405
1974	370	—	—	—
1973	232	—	—	—
1972	185	—	—	—
1971	185	—	—	—
1970	180	—	—	—

*Indicates some discounting from price levels shown.

NORDIC AND EUCALYPTUS PULP PRICES IN EUROPE

(Deutsche marks [DM] or US$/metric ton, c.i.f.)

Year	Northern bleached softwood kraft	Nordic birch	Bleached eucalyptus
1991			
3Q	DM970*	DM900*	ECU435*
2Q	DM1,050*	DM900*	ECU430*
1Q	DM1,060*	DM900*	ECU440*
1990			
4Q	DM1,150*	DM980*	ECU440*
3Q	DM1,250*	DM1,040*	ECU500*
2Q	DM1,400*	DM1,250*	ECU610*
1Q	DM1,400	DM1,300	ECU640
1989			
4Q	DM1,630	DM1,520	DM1,505
3Q	DM1,630	DM1,520	DM1,505
2Q	DM1,530	DM1,440	DM1,440
1Q	DM1,430	DM1,340	DM1,340
1988			
4Q	DM1,430	DM1,340	DM1,340
3Q	DM1,315	DM1,240	DM1,240
2Q	DM1,250	DM1,190	DM1,190
1Q	DM1,180	DM1,130	DM1,130
1987			
4Q	DM1,180	DM1,130	DM1,075
3Q	DM1,125	DM1,075	DM1,075
2Q	DM1,125*	DM1,075	DM1,075
1Q	DM1,125*	DM1,075	DM1,075
1986			
4Q	DM1,100*	DM1,075	DM1,075
3Q	DM1,100*	DM1,025	DM1,025
2Q	DM1,080*	DM985	DM965/985
1Q	DM1,050*	DM910	DM900/$350
Year end			
1985	DM1,025*	DM875*	$330*
1984	DM1,425*	DM1,325*	$435*
1983	$430*	$400	$390/400
1982	$420*	$390	$380*
1981	$545	$520	$480*
1980	$545	$520	$520
1979	$465/475	$450	$445
1978	$380	$360	$345
1977	$350	$325*	—
1976	$415	$405*	—
1975	$415	$405	—
1974	$370	$362	—
1973	$232	$220	—
1972	$185	$180	—
1971	$185	$180	—
1970	$180	$170	—

*Indicates discounting. List prices shown for 1986-89.

Under price-fixing settlements reached with the European Economic Community, Nordic producers increasingly began to make sales in local currencies in the second half of 1984. Eucalyptus increasingly priced in European currency units (ECU).

business has been undermined," one supplier explained.

Courtaulds Fibers Inc.'s Tencel mill, which is under construction in Axis, Ala., will provide another outlet for dissolving pulp. The $80-million plant is scheduled to be up and running by mid-1992. The facility will convert dissolving pulp into cellulosic fiber via a proprietary solvent spinning process and will have an initial capacity of 20,000 tpy. Among other applications, the fiber will be used in making apparel and in industrial applications that can take advantage of its high fiber strength.

Another potential customer to keep an eye on is eastern Germany, where rayon mills could be due for an infusion of cash, producers speculate. Akzo was rumored to be considering the acquisition of one or two rayon mills there.

On the other side of the supply/demand equation, a number of dissolving pulp mills closed in 1990-91 in Europe and Scandinavia. Metsä Serla Oy's 42,000 tpy of dissolving pulp output at its Mänttä mill in Finland went offline in February 1991. Norske Skogindustrier A/S's Saugbrugsforeningen mill in Halden, Norway, was scheduled to shut down its 80,000-tpy dissolving production in mid-year. Germany's Westfälische Zellstoff AG mill was said to have closed in fourth-quarter 1990, bringing 40,000 tpy of dissolving pulp off the market. Bayerische Zellstoff GmbH's Kelheim mill in Germany also reputedly came off the market. Rauma-Repola Oy is expected to convert its 140,000-tpy sulfite dissolving pulp mill in Finland to an integrated paper pulp mill within a year or two.

NORTH AMERICAN CHEMI-THERMOMECHANICAL PULP MILLS—EXISTING AND PROPOSED

Company	Location	Capacity (000 metric tpy)	Startup date
Quesnel River	Quesnel River, B.C.	160 H/S[1]	1983/88
Tembec	Temiscaming, Que.	100 H/S/F	1986
Stone-Consolidated	Bathurst, N.B.	90 H/S[2]	1986
Cascades	Port Cartier, Que.[3]	180 S/F	1988
Fibreco Pulp	Taylor, B.C.	180 S	1988
Millar Western	Whitecourt, Alta.	210 H/S	1988
Slave Lake Pulp	Slave Lake, Alta.[4]	110 H	1990
Donohue Matane	Matane, Que.[3]	190 S	1990/91
Louisiana-Pacific	Chetwynd, B.C.	160 H	1991
Tembec	Temiscaming, Que.	150 H/S[5]	1991
Millar Western	Meadow Lake, Sask.[6]	240 H/S	1992
Vanderhoof	Vanderhoof, B.C.	n.a.	n.a.
YFY	Alberta	240 H/S[7]	n.a.

H = hardwood (mainly aspen); S = softwood (mainly spruce); F = fluff grade.

n.a. = Not available.

1. Reflects about half of total mill capacity marketed by West Fraser; remainder mainly TMP shipped to Japanese partner, Daishowa Paper.
2. Reflects about half of total capacity available for market sale (mainly unbleached).
3. Shut down indefinitely in 1991.
4. Owned 75% by Alberta Energy, 25% by MoDo of Sweden.
5. About 70,000 tpy is used in an adjacent bleached board machine.
6. Owned 51% by Millar Western, 49% by Crown Management Board of Saskatchewan.
7. Some will be integrated with fine paper production.

Source: *Pulp & Paper Week*.

Formosa Plastics Corp. USA, on the other hand, hopes to put up a 2,000-tpd dissolving pulp mill and a rayon plant in Louisiana. And Saiccor Pty Ltd. has approved a 100,000-tpy expansion expected to come on in 1992-93.

The price for 91- to 92-alpha viscose softwood dissolving pulp used to make rayon was in the low to mid-$700s/ton in the U.S. and Western Europe in third-quarter 1991, the mid- to high $600s in Japan and People's Rep. China, and below $650 in Taiwan and Southeast Asia, according to different suppliers. In Western Europe, 93-alpha pulp was going for $750 to $775, and in Eastern Europe it was in the high $600s to low $700s. In the 96- to 97-alpha acetate dissolving pulp sector, one supplier said prices were down about $25 in the U.S., Japan, and Europe, which presumably brought tabs to the low to mid-$800s. Producers conceded that they might have to swallow yet another price drop in the following three to six months.

FLUFF PULP

Fluff pulp demand is expanding at just 2% to 3%/year, but that measured pace may be misleading given the evolution occurring within the industry. Most fluff is used to make diapers, linking the fluff business to changes in population and prosperity worldwide. Environmental forces, the emergence of fluff substitutes, and market pressures that tie the price of fluff to that of paper pulps are also reshaping the industry.

Fluff pulp is usually produced in roll form and shipped to manufacturers of sanitary disposable products, who then disintegrate the thick pulp sheets into individual fibers to give their products bulk, softness, and high absorbency.

Diapers account for three-quarters of fluff pulp consumption, feminine napkins take up about 15%, and adult incontinence products and other applications account for the remainder. In the U.S.—where Procter & Gamble holds about 50% of the diaper market and Kimberly-Clark Corp. about 34%, growth in disposable diaper demand is essentially tied to population expansion and hence is expected to be fairly low. But demand growth for diapers in the Mid-East, Far East, and Eastern Europe—particularly in eastern Germany—is expected to get a boost from rising disposable incomes. In fact, U.S. fluff exports are showing "excellent growth," noted one industry observer (fluff is not imported into the U.S.). As the population ages in the more fully developed countries, demand is growing for incontinence products. Fluff pulp demand in this sector is expected to rise about 10%/year over the next few years in the U.S. The new training pant products are also giving a boost to the fluff business. And the use of sanitary napkins is rising.

When superabsorbents came on the scene in the mid-1980s, the fluff market went into a decline, losing a few hundred thousand tons of demand. Diapers at the time weighed 55 g, and superabsorbents reportedly replaced about 20 g of fluff. Since that time, growth in end-product demand has overcome the impact of the superabsorbents on fluff demand. However, fluff consumption will continue to be affected as producers seek thinner diapers and sanitary napkins that use less fluff and more superabsorbents and as superabsorbent use spreads geographically. Superabsorbents are having another, more subtle impact on fluff use. Diapers containing superabsorbents are staying on babies longer because the chemicals soak up liquid and make the diaper feel drier to parents. That has brought the average number of diapers used in a day from 4.7 down to 4.5 to 4.6.

Other fluff alternatives are popping up, which could further restrain growth in fluff consumption. Johnson & Johnson is testing out sphagnum moss as a fluff substitute in Canadian sanitary protection products. And a trend is developing in sanitary pad production to move away from fluff altogether. The ultrathin pads involved are only about one-fourth or one-fifth the thickness of ordinary pads and make use of nonfluff woodpulp.

Worldwide production of fluff totals about 2.5 million metric tons, with North America providing about three-quarters of that volume. Sulfate fluff accounts for 80% of the world output, and sulfite and BCTMP grades take half each of the remainder.

While Scandinavia and parts of northern Europe have shown some acceptance of BCTMP fluff, the outlook for the product looks bleak. One drawback is the pulp's performance. The rate of absorbency of BCTMP is inferior to that of chemical pulp, particularly southern pine, according to some in the industry, and BCTMP's integrity in a pad is not as good. Only a few BCTMP mills can provide the pulp in the roll form preferred by diaper plants. In addition, BCTMP's environmental advantage as a non-chlorine-bleached pulp is diminishing as chemical pulp suppliers have been giving up elemental chlorine themselves. And fluff BCTMP has been hurt in the U.S. by its lower brightness. Nevertheless, one export marketing manager estimated that fluff BCTMP consumption in Europe hit 170,000 tons in 1989 and will reach 230,000 in 1995.

Apart from downtime among fluff BCTMP producers, such as Cascades Port Cartier, fluff supply and demand appeared to be fairly well in balance in mid-1991, with U.S. producers running full. Weyerhaeuser Co.'s Columbus, Miss., mill, which went online in May 1990 and produces some fluff, created few ripples in the market. Other firms are said to be adding incremental tonnage, but no greenfield projects are expected in the near future. Considering both integrated and market production, the top fluff producers (with their estimated capacity) include Procter & Gamble (approximately 500,000 to 550,000 metric tpy in capacity), Weyerhaeuser (about 500,000 tpy), International Paper Co. (nearly 400,000 tpy), ITT Rayonier Inc. (about 330,000 tpy), and Kimberly-Clark (200,000 tpy).

Because it is more expensive to produce, fluff pulp normally sells at a premium to southern pine paper pulp (but seems to track the price of northern softwood more closely, perhaps because of contractual arrangements).

Prices for U.S. fluff pulp (untreated softwood kraft in rolls) peaked in mid-1989 at $830/metric ton on the domestic market and $850/ton in northern Europe. These prices held for a while, but from first-quarter 1990 to third-quarter 1991, tabs dropped almost every quarter. Fluff was selling for $650/metric ton on the domestic market in the third quarter and in the range of $640 to $650 delivered to northern European ports c.i.f. Opinions were mixed as to whether or not further reductions might occur. The decline was, of course, related to fluff supply and demand, but the general weakness throughout the entire pulp industry had even more of an impact.

NORTH AMERICAN DISSOLVING PULP PRODUCERS ESTIMATED MILL CAPACITIES[1]

(000 metric tons)

Company	Prehydrolyzed sulfate pulp	Sulfite pulps	Cotton linters
ITT Rayonier			
Fernandina Beach, Fla.	—	145	—
Jesup, Ga.	280	—	—
Port Angeles, Wash.	—	145	—
Hoquiam, Wash.	—	—[2]	—
Buckeye Cellulose			
Perry, Fla.	180	—	—
Memphis, Tenn.	—	—	85
Alaska Pulp			
Sitka, Alaska	—	170	—
International Paper			
Natchez, Miss.	225	—	—
Tembec Forest Products			
Temiscaming, Que.	—	120	—
Louisiana-Pacific			
Ketchikan, Alaska	—	190	—
Western Pulp			
Port Alice, B.C.	—	160	—
Weyerhaeuser			
Cosmopolis, Wash.	—	65	—
Alpha Cellulose			
Lumberton, N.C.	—	—	40
Southern Cellulose			
Chattanooga, Tenn.	—	—	30
Total	**685**	**995**	**155**

[1] Estimates of dissolving pulp capacity include some paper and fluff pulp. American Paper Institute and Canadian Pulp & Paper Assn. estimate U.S. dissolving pulp capacity at 1.386 million tons and Canadian capacity at 247,000 tons for a total of 1.633 million tons.

[2] Hoquiam mill has been supplying only slush pulp to adjacent Grays Harbor Paper Co. mill in recent years.

Fiber:

WASTEPAPER

Wastepaper is used as a lower-grade alternative to virgin pulp in the manufacture of paper and paperboard. Also referred to as paperstock, recyclable paper, and secondary fiber, it is not as widely used as woodpulp because of quality considerations—but its growth rate will surpass that of woodpulp in the 1990s because of environmental pressures. Successive repulping tends to lower the quality of recycled fiber, eventually making it unusable. Primary fibers are often added to maintain strength and other qualities.

Forces outside the marketplace have in this decade begun to have a pronounced effect on future use of wastepaper in paper and paperboard production. Throughout the world, a "green" movement is changing the way consumers view products made from recycled materials, and producers are responding with new recycled and recyclable products. In addition, governments are rapidly reacting to solid waste problems by adopting laws to promote recycling.

The North American paper industry itself will spend hundreds of millions of dollars to convert a considerable portion of its capacity to incorporate at least some recycled fiber. A special survey conducted by the American Paper Institute in November 1989 found that U.S. mills' capital investment plans would account for a consumption level of 31.4 million short tons of wastepaper by 1995, a 50% increase in usage over the approximately 20 million short tons consumed in 1988. Most of wastepaper consumed will be old corrugated containers (OCC) and old newspapers (ONP). Updating its numbers, API reported in December 1990 that the paper industry was expected to expand total consumption of wastepaper at a pace averaging 7.2%/year during 1991-93 (an increase from the 5.9% average annual growth rate API had projected a year earlier) to reach 27,148,000 short tons in 1993.

The industry uses two main indicators of wastepaper consumption: the utilization rate and the ratio of wastepaper used to total fiber furnish. Utilization is calculated as a ratio of wastepaper consumed to total paper and paperboard produced. The utilization rate is slightly higher than the other figure due to the loss of fiber in papermaking.

Data on wastepaper consumption are collected by the Dept. of Commerce and API in the U.S. and by the Canadian government and Canadian Pulp & Paper Assn. in Canada. API figures are generally higher than those from the Dept. of Commerce because API includes inplant and intraplant use of paper machine trim and broke.

The percentage of recyclable paper used in overall fiber furnish in the U.S. did not change appreciably in the decades of the 1970s and 1980s. With only minor setbacks along the way, it grew in those 20 years from 21.5% in 1970 to just 25.3% in 1989, according to API figures. However, during the period 1990-93, API expects secondary fiber use to grow at more than three times the rate of woodpulp. The percentage of recycled fiber to woodpulp will increase to 29.3% by 1993, while woodpulp will decline to 70.3% of fiber supply in 1993 from 74.3% in 1989.

Wastepaper utilization has also varied only slightly during more than two decades. Between 1965 and 1978, it remained at about 23%. After 1978, it crept past 24% and then began growing by a percentage point or more, topping 25% in 1988. It reached 26.1% in 1989 and 28.0% in 1990 and in 1991 is expected to exceed 30%.

Aside from significant increases in utilization rates and ratios of usage in overall fiber furnish, the wastepaper market in 1990 was driven by record U.S. mill consumption of 20.044 million short tons, according to API. International trade was also robust in 1990, with U.S. paperstock exports reaching a new high of 6.506 million short tons. Major consuming countries in 1990, in descending order, were Rep. Korea, Taiwan, Mexico, Japan, Canada, Indonesia, Spain, Italy, and the Phillipines.

SUPPLY

The wastepaper industry collects material from many sources, sorts and segregates it into various types, and processes it for ease of handling, transport, and subsequent repulping. Balers and other costly equipment are required to perform these functions. The collection of wastepaper also provides important secondary services, such as reduction of solid wastes and savings on garbage disposal costs—factors that are becoming increasingly important as recycling gains popularity in the public eye.

Sources of paperstock are categorized generally as either pre- or postconsumer. Preconsumer generators of secondary fiber are primarily converting plants and printers. Converting plants produce recyclable products such as envelopes, books, and business forms. Printers are sources for materials such as magazines, directories, and catalogs. In these operations, waste is generated from machine trim as well as from other manufacturing operations. Postconsumer generators of waste include residential homes, factories, offices, and retail outlets.

Environmental and government representatives have been supporting the concept of using more postconsumer wastepaper in recycled paper and paperboard, believing that only postconsumer grades can legitimately be considered to have been pulled out of the solid waste stream. However, the paper industry claims that preconsumer grades would wind up as solid waste if they were not used in paper and paperboard production.

Two groups are spearheading attempts to reach a consensus on recycling definitions and standards. One is the National Recycling Coalition (NRC), through its Recycling Advisory Council (RAC). The other is the American Society for Testing & Materials (ASTM), through its Recycled Paper Subcommittee.

RAC has proposed a two-part standard for determining recycled paper and paperboard that includes either establishing percentages of total recycled content or determining processed secondary fiber content based on fiber weight. ASTM is working to define nearly 70 specific terms and had reached agreement on 17 definitions by mid-1991. Some of the most difficult terms yet to be agreed upon included recyclable, postconsumer recovered material, and deinking.

In determining the supply of paperstock, industry experts watch the recovery rate. This is defined by API as the ratio of recyclable paper collected to new supply of paper and board (new supply of paper and board equals production plus imports less exports, excluding hard pressed board; imports and exports include paper and paperboard converted products).

Overall, the recyclable recovery rate has been climbing

WASTEPAPER UTILIZATION BY U.S. PAPER AND BOARD MILLS, BY GRADE

(000 short tons)

Year	Total	Mixed papers	%	Newspapers	%	Corrugated	%	Pulp substitutes*	%	Deinking	%
1993e	27,148	3,007	11.1%	5,353	19.7%	13,298	49.0%	3,177	11.7%	2,313	8.5%
1992e	25,362	2,875	11.3	4,994	19.7	12,151	47.9	3,077	12.1	2,264	8.9
1991e	23,826	2,723	11.4	4,457	18.7	11,593	48.7	2,950	12.4	2,103	8.8
1990	22,044	2,583	11.7	4,096	18.6	10,731	48.7	2,709	12.3	1,925	8.7
1989	20,442	2,356	11.5	3,638	17.8	9,993	48.9	2,642	12.9	1,812	8.9
1988	19,886	2,182	11.0	3,215	16.2	9,909	49.8	2,889	14.5	1,691	8.5
1987	19,201	2,116	11.0	3,442	17.9	9,177	47.8	2,903	15.1	1,563	8.3
1986	18,128	2,045	11	3,118	17	8,634	48	2,761	15	1,570	9
1985	16,550	1,902	12	2,875	17	7,899	48	2,494	15	1,380	8
1984	16,883	1,975	12	2,895	17	7,972	47	2,673	16	1,369	8
1983	15,822	1,908	12	2,692	17	7,443	47	2,456	16	1,323	8
1982	14,620	1,707	12	2,673	18	6,770	46	2,247	15	1,224	8
1981	15,883	2,356	15	2,667	17	7,231	46	2,382	15	1,247	8
1980	15,094	2,268	15	2,564	17	6,866	45	2,254	15	1,142	8
1979	15,520	2,648	17	2,480	16	6,967	45	2,308	15	1,117	7
1978	14,760	2,729	18	2,212	15	6,721	45	2,242	15	1,068	7
1977	14,288	2,773	19	2,287	16	6,205	43	2,079	14	944	7
1976	13,822	2,798	20	2,278	17	5,696	41	2,117	15	933	7
1975	11,983	2,606	22	2,040	17	4,743	40	2,594*	22	—	—
1974	14,196	3,118	22	2,408	17	5,716	40	2,955*	21	—	—
1973	14,318	3,371	24	2,456	17	5,292	37	3,199*	22	—	—
1972	13,132	3,054	23	2,317	18	4,722	36	3,037*	23	—	—
1971	12,323	2,776	22	2,174	18	4,277	35	3,097*	25	—	—
1970	12,021	2,639	22	2,235	19	4,080	34	3,067*	25	—	—

*Pulp substitutes include deinking grades prior to 1976.
e = American Paper Institute estimate.
Source: American Paper Institute Capacity Survey for relevant years, 1970-93.

for the past two decades, with minor setbacks along the way. It has hovered at about 26% since 1980, but that barrier was broken in 1986 when the rate jumped two points to 28%. This was due not only to a 13.3% rise in exports but also to a 7.4% increase in the amount of recyclable paper collected for recycling.

The collection of wastepaper continued to rise in the closing years of the 1980s, according to API data. In 1987, it reached 24.033 million short tons for a 28.8% recovery rate; in 1988, 26.179 million tons (29.9% recovery); and in 1989, 27.601 million tons (32.4% recovery). In 1990, collections reached 28.926 million tons, equivalent to 33.4% of paper and board new supply. API expects the industry to reach a goal of 40% recovery by 1995 and is encouraged by the increase in collections in recent years.

UTILIZATION OF WASTEPAPER BY U.S. PAPER/BOARD MILLS

(000 short tons)

Year	Wastepaper used*	Paper/board produced	Utilization rate (%)
1993e	27,148	n.a.	n.a.
1992e	25,362	n.a.	n.a.
1991e	23,826	77,971	30.6%
1990	22,044	78,834	28.0
1989	20,442	78,274**	26.1
1988	19,684	78,025**	25.2
1987	18,694	75,958**	24.6
1986	17,935	72,505**	24.7
1985	16,371	68,688**	23.8
1984	16,724	70,248**	23.8
1983	15,638	66,748**	23.4
1982	14,433	60,951**	23.7
1981	15,037	64,259	23.4
1980	14,922	63,600	23.5
1979	15,361	64,345	23.9
1978	14,760	62,047	23.8
1977	14,058	60,040	23.4
1976	13,622	58,329	23.4
1975	11,748	50,976	23.0
1974	13,982	59,040	23.7
1973	14,094	59,900	23.5
1972	12,925	57,434	22.5
1971	12,106	53,163	22.8
1970	11,803	51,671	22.8

e = Estimate.

*Includes tonnage consumed in the production of construction grades and molded pulp products.

**Includes the following tonnages for construction and wet machine board grades: 1982, 1,662,000 tons; 1983, 1,800,000 tons; 1984, 1,800,000 tons; 1985, 1,700,000 tons; 1986, 1,600,000 tons; 1987, 1,590,000 tons; 1988, 1,570,000 tons; and 1989, 1,570,000 tons.

Sources: Wastepaper utilization from American Paper Institute Capacity Survey for 1989-93. Production totals and historical wastepaper utilization figures from API's "Statistics of Paper, Paperboard & Wood Pulp" and from "Paper, Paperboard & Wood Pulp Monthly Statistical Survey."

GOVERNMENT ACTION

An increasing amount of paper and paperboard is being recycled because of growing concern about the environment and because of the need to find alternate means of waste disposal. In the 1980s, densely populated areas—particularly in the northeastern U.S.—have had to close down most of their landfills and look for other disposal methods.

The U.S. generates about 180 million short tpy of municipal solid waste (MSW), about 73% of which is disposed of in landfills, according to 1988 data compiled by Franklin Associates Ltd. By the year 2000, 216 million short tons of MSW will be generated, and only 49% of this will be discarded in landfills; the remainder will be either recycled (25%) or incinerated (26%), according to Franklin's estimates. Because wastepaper accounts for almost half of all solid waste, the paper industry will inevitably be involved in efforts to recycle more of it.

An estimated one-third of the primary paper and board mills in operation during 1990 used wastepaper as their principal fiber component, while another 50% used between 10% and 50% waste materials in their papermaking process, according to the Dept. of Commerce's "Industrial Outlook" for 1991. At least 37 planned expansions of mills that use recyclable paper and board were announced in

U.S. WASTEPAPER DOMESTIC UTILIZATION AND EXPORTS

(000 short tons)

Year	Used	Exported	Total	Exports as percent of total
1990	22,044	6,434	28,478	23%
1989	20,442	6,079	26,521	23
1988	19,887	5,640	25,527	22
1987	19,201	4,418	23,623	19
1986	18,128	3,724	21,636	17
1985	16,550	3,283	19,657	17
1984	16,883	3,268	19,959	16
1983	15,822	2,393	18,212	13
1982	14,620	2,127	16,560	13
1981	15,883	2,213	17,659	13
1980	15,094	2,664	17,972	15
1979	15,520	2,233	17,594	13
1978	14,760	1,599	16,359	10
1977	14,288	1,512	15,570	10
1976	13,822	1,273	14,895	9
1975	11,983	861	12,843	7
1974	14,196	1,307	15,289	9
1973	14,318	683	14,777	5
1972	13,132	415	13,340	3
1971	12,323	419	12,525	3
1970	12,021	408	12,211	3

Sources: American Paper Institute Capacity Survey; Dept. of Commerce.

1990, DOC reported.

Early in 1990, API announced that the industry had set a goal to recover 40% of all paper used in the U.S. by the end of 1995. To meet this goal, the collection system will be challenged, especially as new mills, new machines in existing mills, and increases in capacity of machines currently making recycled paper and paperboard come onstream.

The paper industry has recycled for hundreds of years, but never has it been forced to absorb as much additional recycled fiber. The problem started as a number of isolated solid waste problems began to crop up. The Islip (Long Island) barge incident is seen as a major turning point in public perception, but New Jersey's garbage crisis really set some legislative wheels in motion. New Jersey closed all but 20 of its landfills by 1984, and no new ones were sited. In 1987, a law was passed in New Jersey requiring all communities to mandate recycling programs. However, the state didn't consider where all that additional collected recyclable material was going to be marketed.

Many states followed New Jersey's lead by setting up their own recycling systems or by studying such programs. Thirty-three states now have comprehensive recycling laws that require separation of recyclables and/or provisions to stimulate recycling, according to the National Solid Waste Management Assn. (NSWMA). Since January 1989, 48 states have enacted some type of recycling law. The two states without recycling laws, Idaho and South Carolina, had bills pending in 1991, according to NSWMA.

As these recycling programs generated more and more recyclables, it became apparent that demand for them wasn't growing proportionately. Something had to be done to expand the marketplace. Some states, in the interim, paid mills to take the excess ONP rather than paying high tipping fees at landfills or paying to transport the solid waste hundreds of miles. Some recycling centers shut down because they couldn't make a profit in such a market.

Now, states are adopting new laws to promote markets for recyclables. So far, this has concentrated mainly on getting newsprint producers to use more ONP in their fiber furnishes (see Newsprint chapter). More recently, though, states are looking at laws to stimulate recycled fiber demand in other sectors of the paper industry, such as printing/writing grades and packaging. States and municipalities are also requiring their purchasing agents to procure paper containing certain percentages of recycled fiber.

Eight states and two localities now require newsprint manufacturers to use recycled materials, according to the American Newspaper Publishers Assn. Connecticut and California were the first states to enact these laws with 1989 mandates that responded to the glut of ONP. Arizona, Illinois, Oregon, Maryland, Missouri, Wisconsin, Suffolk County, N.Y., and Washington, D.C., also have laws that require newsprint publishers to use specified percentages of recycled newsprint. Other recycled-content mandates address trash bags and glass, food and beverage containers (California), telephone books (Connecticut and Oregon), and plastic containers (Wisconsin).

The federal government has had to buy recycled paper since June 1989, according to Section 6002 of the Resource Conservation & Recovery Act (RCRA). On June 14, the Government Printing Office accepted its first bid for printing/writing paper specifying recovered material content. The federal law states that all agencies of the federal government must implement a preference purchasing program favoring recycled items. This applies to state and local government agencies funded by the federal government that buy $10,000 or more of the designated grades.

The paper procurement guideline was established by the Environmental Protection Agency (EPA) and applies to 24 paper and paperboard grades. For example, newsprint must contain at least 40% postconsumer wastepaper. Offset printing paper, envelopes, mimeograph and duplicating paper, ledger, bond, book paper, and stationery must contain 50% recycled wastepaper. Toilet tissue must contain 20% postconsumer wastepaper, towels must contain 40%, and corrugated cartons must contain 35%. Information on the federal procurement program can be obtained from the EPA procurement guidelines hotline: (703) 941-4452.

In Canada, the federal government is trying to stimulate demand for recycled paper products through its Environmental Choice Program. Canada has no federal mandatory procurement law. The Environmental Choice Program is

WASTEPAPER AS PERCENT OF FIBER FURNISH IN U.S. PAPER/BOARD PRODUCTION

(000 short tons)

Year	Wastepaper-	Total woodpulp other fibers	Percent of wastepaper
1993e	27,148	65,524	29.3%
1992e	25,362	65,258	28.0
1991e	23,826	64,005	27.1
1990	22,044	61,739	26.3
1989	20,442	60,313	25.3
1988	19,887	59,773	24.9
1987	19,201	59,887	24.4
1986	18,128	58,105	24.6
1985	16,550	54,566	23.7
1984	16,883	55,174	23.3
1983	15,822	51,834	23.2
1982	14,620	48,440	23.2
1981	15,217	51,764	22.7
1980	15,094	51,028	22.8
1979	15,400	51,303	23.1
1978	14,760	54,074	21.5
1977	14,288	49,799	22.3
1976	13,822	48,082	22.3
1975	11,983	43,104	21.8
1974	14,196	49,130	22.4
1973	14,318	49,558	22.4
1972	13,132	48,032	21.5
1971	12,323	44,805	21.5
1970	12,021	43,802	21.5

e = Estimate

Calculated by *Pulp & Paper* from American Paper Institute data.

voluntary. Manufacturers apply to the Canadian Standards Assn. for a license allowing them to display the three-dove symbol of the Environmental Choice Program on their products. The success of the program relies on the consumer making a choice in the marketplace.

To display the symbol, a manufacturer must not only meet certain requirements related to recycled content but also pass performance standards; plus, the mill itself must adhere to federal and provincial environmental control regulations. Canada's Environmental Choice Program is modeled after the "Blue Angel" program that has been operating in Germany since 1978.

The Canadian government has also given its support to Canada's new National Packaging Protocol, a policy statement that set ambitious targets for reducing packaging waste. Developed by a task force, the protocol was endorsed in 1990 by the Canadian Council of Ministers of the Environment. Under the protocol, packaging sent for disposal by Dec. 31, 2000, shall weigh no more than half as much as the packaging waste disposed of in 1988. The pre-

PRICES FOR WASTEPAPER BY SELECTED GRADE IN FOUR MARKETS

($/short ton, f.o.b. seller's dock)

NO. 6 NEWS

	NYC	Chicago	Atlanta	SF-LA
1991				
2Q	-$3.33	$10.00	$19.16	$56.66
1Q	0.00	8.33	20.00	31.66
1990				
4Q	-1.33	4.16	16.66	30.83
3Q	-4.60	-8.30	12.50	28.33
2Q	-1.66	22.50	12.50	28.33
1Q	-5.00	15.00	12.50	27.50
1989				
4Q	-16.00	12.50	12.50	26.66
3Q	-5.00	7.50	14.16	23.33
2Q	9.16	11.66	21.66	34.16
1Q	17.50	22.50	27.50	42.50
1988				
4Q	35.00	30.00	35.83	45.00
3Q	45.83	42.50	52.50	59.16
2Q	50.00	44.16	52.50	68.33
1Q	58.30	55.00	54.16	78.33
1987				
4Q	55.00	54.17	49.17	75.00
3Q	44.16	40.83	38.33	75.00
2Q	47.50	42.50	40.83	71.66
1Q	40.00	37.50	42.50	65.83
1986				
4Q	25.00	24.16	30.00	40.00
3Q	31.67	32.50	41.67	46.67
2Q	35.00	30.83	35.00	45.00
1Q	30.00	22.50	37.50	48.12
Year end				
1985	25.00	22.50	30.00	40.00
1984	42.50	47.50	42.50	45.00
1983	42.50	47.50	47.50	51.25
1982	30.00	37.50	32.50	45.00
1981	27.50	22.50	32.50	30.00
1980	45.00	50.00	57.00	53.50

Note: Prices reflect paper and board mill purchase prices, f.o.b. seller's dock exclusive of delivery charges, and they represent contract rather than spot or premium sales.
Source: *Pulp & Paper Week*

PRICES FOR WASTEPAPER BY SELECTED GRADE IN FOUR MARKETS

($/short ton, f.o.b. seller's dock)

OLD CORRUGATED CONTAINERS

	NYC	Chicago	Atlanta	SF-LA
1991				
2Q	$26.66	$27.50	$37.50	$83.33
1Q	35.00	27.50	42.50	65.00
1990				
4Q	23.33	24.16	42.50	60.83
3Q	20.00	24.16	40.83	55.83
2Q	16.66	27.50	37.50	47.50
1Q	12.50	22.50	37.50	57.75
1989				
4Q	17.50	27.50	28.33	58.50
3Q	20.83	23.33	27.50	60.83
2Q	29.16	29.16	30.83	60.83
1Q	35.00	32.50	37.50	30.83
1988				
4Q	43.33	37.50	39.16	60.00
3Q	55.83	45.83	60.00	76.66
2Q	51.66	42.50	50.00	82.50
1Q	52.50	47.50	49.17	92.50
1987				
4Q	54.17	54.17	70.00	99.17
3Q	71.66	70.00	76.66	104.16
2Q	47.50	42.50	40.83	71.66
1Q	40.00	37.50	42.50	65.83
1986				
4Q	22.50	25.00	32.50	46.66
3Q	45.83	50.83	55.00	77.50
2Q	33.33	36.67	35.83	55.00
1Q	25.00	26.66	32.50	46.25
Year end				
1985	22.50	25.00	32.50	50.00
1984	37.50	46.25	50.00	50.00
1983	47.50	60.00	67.50	70.00
1982	30.00	30.00	37.50	32.50
1981	27.50	33.50	34.50	40.00
1980	33.00	44.00	43.00	57.00

Note: Prices reflect paper and board mill purchase prices, f.o.b. seller's dock exclusive of delivery charges, and they represent contract rather than spot or premium sales.
Source: *Pulp & Paper Week*

liminary goals are 20% diversion by Dec. 31, 1992, and 35% by Dec. 31, 1996. Half of this diversion shall be achieved through new source reduction and new reuse initiatives, with recycling making up the remainder. Private sector participation is voluntary, but the government says it will implement regulations quickly if the goals are not met. Waste reduction goals included in the protocol apply to all packaging used in Canada, including imports.

This is in contrast to the mandatory approach taken in the U.S. States are approaching this new regulatory arena in an array of inventive ways, with hundreds of proposals being reviewed per session. Manufacturers are finding it difficult to keep up with the regulations. According to API, municipal solid waste proposals being considered for adoption in state legislatures in April 1991 included the following categories (with the number of proposals in parenthesis): bans and degradable requirements (17), packaging taxes and restrictions and tax incentives/disincentives (25), source separation and recycling (58), state purchasing pref-

PRICES FOR WASTEPAPER BY SELECTED GRADE IN FOUR MARKETS

($/short ton, f.o.b. seller's dock)

NEW DOUBLE-LINED KRAFT CORRUGATED CLIPPINGS

	NYC	Chicago	Atlanta	SF-LA
1991				
2Q	$72.50	$71.66	$75.00	$142.50
1Q	69.16	71.66	71.66	130.00
1990				
4Q	54.16	49.16	55.00	98.33
3Q	67.50	60.83	65.00	90.00
2Q	68.33	65.83	69.16	98.33
1Q	65.00	67.50	72.50	105.00
1989				
4Q	65.83	70.83	72.50	117.50
3Q	75.83	84.16	77.50	127.50
2Q	72.50	72.50	73.75	127.50
1Q	57.50	57.50	62.50	107.50
1988				
4Q	69.16	67.50	75.83	109.16
3Q	93.33	94.16	95.83	124.16
2Q	90.83	92.50	97.50	125.83
1Q	99.16	102.50	107.50	134.16
1987				
4Q	83.33	95.83	97.50	135.00
3Q	105.00	110.00	107.50	151.66
2Q	97.50	98.33	97.83	150.00
1Q	82.50	82.50	85.83	130.83
1986				
4Q	42.50	38.33	52.50	75.83
3Q	81.67	87.50	90.83	103.33
2Q	65.00	65.00	60.83	80.00
1Q	50.83	46.66	54.16	76.66
Year end				
1985	42.50	37.50	52.50	77.50
1984	77.50	83.75	77.50	92.50
1983	72.50	77.50	82.50	100.00
1982	45.00	47.50	47.50	70.00
1981	n.a.	n.a.	n.a.	n.a.
1980	n.a.	n.a.	n.a.	n.a.

Note: Prices reflect paper and board mill purchase prices, f.o.b. seller's dock exclusive of delivery charges, and they represent contract rather than spot or premium sales.
n.a. = Not available.
Source: *Pulp & Paper Week.*

PRICES FOR WASTEPAPER BY SELECTED GRADE IN FOUR MARKETS

($/short ton, f.o.b. seller's dock)

HARD WHITE SHAVINGS

	NYC	Chicago	Atlanta	SF-LA
1991				
2Q	$225.00	$225.00	$240.00	$229.16
1Q	248.33	243.33	280.00	280.00
1990				
4Q	266.66	258.33	280.00	323.33
3Q	270.00	281.16	306.66	330.00
2Q	273.33	335.00	331.66	356.66
1Q	308.75	350.00	366.25	392.50
1989				
4Q	327.50	368.33	386.66	404.16
3Q	358.33	398.33	400.00	414.16
2Q	358.00	399.16	403.33	410.83
1Q	355.00	375.00	375.00	385.00
1988				
4Q	335.00	363.33	355.00	368.33
3Q	343.33	365.00	353.33	360.00
2Q	323.33	341.66	340.00	335.00
1Q	320.00	331.66	336.66	345.00
1987				
4Q	296.66	306.66	308.33	345.00
3Q	276.66	275.00	393.33	323.33
2Q	276.66	266.66	293.33	321.66
1Q	285.83	285.00	291.66	316.66
1986				
4Q	180.00	145.00	160.00	188.33
3Q	248.33	226.67	218.33	253.33
2Q	210.00	185.00	188.33	220.83
1Q	187.50	151.66	166.66	195.00
Year end				
1985	180.00	145.00	160.00	190.00
1984	245.00	205.00	240.00	245.00
1983	212.50	215.00	210.00	195.00
1982	200.00	195.00	190.00	180.00
1981	252.50	231.00	232.50	237.50
1980	251.50	278.50	260.00	269.50

Note: Prices reflect paper and board mill purchase prices, f.o.b. seller's dock exclusive of delivery charges, and they represent contract rather than spot or premium sales.
Source: *Pulp & Paper Week.*

erence (six), and waste-to-energy (seven).

The states have taken action because EPA has so far opposed congressional efforts to legislate source reduction. EPA prefers to rely on effecting a cultural change at the local level. It plans to award a small amount of grant money and technical assistance to states and municipalities to encourage recycling. EPA has set a national goal of 25% municipal solid waste recycling by 1992 and 50% by 2008. This program might be accelerated by Congress as it plans to reauthorize RCRA.

By mid-1991, a comprehensive bill to reauthorize RCRA had been introduced by Sen. Max Baucus (D-Mont.). S. 976 focused on source reduction and recycling as well as addressing the interstate movement of waste, international exports, state and regional planning, solid waste permitting criteria, and underground storage tanks. It included specific minimum annual recovery rates for various grades that would have to be achieved by the end of 1995, including ONP (52%), OCC (66%), mixed paper (20%), high-grade deinking (50%), pulp substitutes (100%), and all grades of paper products (40%). If these goals are not met, the EPA administrator would have to set minimum recycled-content standards for those grades.

Another bill by Rep. John Warner (R-Va.) would establish a new subtitle K in RCRA to govern recycling separate from solid waste disposal. S. 3255 would exclude materials in the recycling process from the definition of solid waste and establish a particular regime within RCRA to manage recycling activities.

Lumping recyclable materials along with such materials as hazardous wastes in a general definition for solid wastes is causing problems for the industry outside the U.S. as well. A new international directive also threatens to govern recyclables along with other wastes.

The Basel Convention on the Control of Transboundary Movement of Hazardous & Other Wastes, which was negotiated under the auspices of the United Nations Environmental Program in March 1989, calls for the control of "hazardous and other wastes" among nations that sign the agreement. Those that do not sign the agreement will not be able to trade in these wastes with the nations that do sign it. This means that the U.S., if it signs, may not trade with countries such as Japan and Rep. Korea, which have not signed it.

Another problem is that broad terms and vague definitions in the convention could prohibit the signing nations from trading in some recyclable materials. For instance, because there is no control program for household discards in the convention, international movement of these materials may be banned entirely. Currently 11 nations have signed the Basel Convention. If ratified by 20 nations, it would become effective. However, nations such as the U.S. have proposed that at least some grades of paper and other recyclables be exempted from the stringent regulations imposed on hazardous wastes.

The Institute of Scrap Recycling Industries, the key trade association representing the U.S. recycling industry, has opposed the Basel Convention's implementation if based on a list of hazardous materials that includes such materials as wastepaper. The Basel Convention as it stands now not only discourages market development for recyclables but also unfairly imposes restrictions on recyclable commodities but not on their virgin-fiber-based counterparts.

The Organization for Economic Cooperation & Development (OECD) has begun to establish a "Green List" of materials for which normal commercial practices are environmentally sound. It also has an "Amber List" of materials that could pose a problem if mishandled and for which an expedited form of advance notice and consent would be re-

PRICES FOR WASTEPAPER BY SELECTED GRADE IN FOUR MARKETS

($/short ton, f.o.b. seller's dock)

COMPUTER PRINTOUT (No. 42)*

	NYC	Chicago	Atlanta	SF/LA
1991				
2Q	$176.66	$183.33	$223.33	$212.50
1Q	210.00	195.00	242.50	232.50
1990				
4Q	213.33	201.66	232.50	235.83
3Q	189.16	168.33	169.16	190.00
2Q	211.66	209.16	200.00	231.66
1Q	235.00	217.50	212.50	290.00
1989				
4Q	255.00	234.16	215.00	300.00
3Q	260.83	232.50	215.00	281.16
2Q	230.83	206.66	223.33	271.50
1Q	210.00	200.00	252.50	297.50
1988				
4Q	213.33	205.00	273.33	301.66
3Q	236.66	215.00	290.00	326.66
2Q	230.00	205.00	285.00	301.66
1Q	221.66	191.66	269.16	296.66
1987				
4Q	193.33	166.66	233.33	278.33
3Q	185.00	165.00	215.00	245.00
2Q	185.00	165.00	200.00	235.00
1Q	175.00	165.00	186.66	231.66
1986				
4Q	135.00	126.66	140.83	166.66
3Q	169.17	180.00	192.50	228.33
2Q	143.33	130.00	175.00	209.17
1Q	135.00	125.00	144.16	180.00
Year end				
1985	135.00	125.00	142.50	170.00
1984	205.00	170.00	205.00	245.00
1983	172.50	160.00	155.00	190.00
1982	170.00	145.00	155.00	192.50
1981	177.50	203.50	183.50	178.50
1980	175.50	195.00	158.50	199.00

*One hundred percent laser content after 1988.

Note: Prices reflect paper and board mill purchase prices, f.o.b. seller's dock exclusive of delivery charges, and they represent contract rather than spot or premium sales.

Source: *Pulp & Paper Week*.

quired if shipped for recycling within the OECD and a "Red List" of hazardous recyclables that should not be treated any differently from wastes for final disposal even if they are recycled.

COLLECTION SYSTEMS

Collection systems differ for the major categories of wastepaper. ONP used to be generated by residences and donated to nonprofit organizations during paper drives. With the spread of mandatory recycling efforts, however, many nonprofit organizations have chosen other fundraisers because collecting ONP is no longer profitable.

API reported that total collection of ONP in 1990 topped 5.9 million short tons, an increase of 9.2% from 1989 and up 78.8% from 1980. API estimated that the tonnage recovered in 1990 was equal to nearly 45% of the newsprint used in the U.S. and forecasts that recycling of ONP will continue to grow during the 1990s above the rate of U.S. newsprint consumption.

OCC is obtained mostly from retail stores, factories, and office buildings. Only about 25% is supplied by postconsu-

PRICES FOR WASTEPAPER BY SELECTED GRADE IN FOUR MARKETS

($/short ton, f.o.b. seller's dock)

MANIFOLD COLORED LEDGER

	NYC	Chicago	Atlanta	SF-LA
1991				
2Q	$80.00	$105.00	$93.33	$105.00
1Q	100.00	107.50	100.00	107.50
1990				
4Q	100.00	107.50	100.00	114.16
3Q	105.00	114.16	113.33	133.33
2Q	113.33	128.33	115.00	145.00
1Q	125.00	140.00	135.00	160.00
1989				
4Q	128.33	145.00	135.00	144.16
3Q	125.00	145.00	131.66	144.16
2Q	115.00	141.66	127.50	141.66
1Q	112.50	140.00	127.50	152.50
1988				
4Q	119.16	150.00	138.33	159.16
3Q	125.00	160.00	150.83	173.33
2Q	125.00	153.33	149.16	165.83
1Q	122.50	146.66	138.33	128.33
1987				
4Q	112.50	137.50	118.33	110.83
3Q	90.83	121.66	111.66	107.50
2Q	85.83	106.66	91.66	107.50
1Q	78.33	90.00	90.00	102.50
1986				
4Q	79.16	80.00	73.33	70.00
3Q	88.33	81.67	85.00	72.50
2Q	72.50	81.67	77.50	77.50
1Q	72.50	80.00	72.50	68.33
Year end				
1985	72.50	80.00	70.00	70.00
1984	115.00	125.00	120.00	117.50
1983	112.50	105.00	90.00	65.00
1982	67.50	90.00	85.00	55.00
1981	110.00	112.50	107.50	115.00
1980	127.50	122.50	127.50	127.50

Note: Prices reflect paper and board mill purchase prices, f.o.b. seller's dock exclusive of delivery charges, and they represent contract rather than spot or premium sales.
Source: *Pulp & Paper Week.*

PRICES FOR WASTEPAPER BY SELECTED GRADE IN FOUR MARKETS

($/short ton, f.o.b. seller's dock)

MANIFOLD WHITE LEDGER

	NYC	Chicago	Atlanta	SF/LA
1991				
2Q	$136.66	$140.00	$155.00	$137.50
1Q	146.66	140.00	157.50	140.00
1990				
4Q	154.16	140.83	158.33	144.16
3Q	148.33	156.66	163.33	150.00
2Q	168.33	174.16	183.33	186.66
1Q	190.00	187.50	210.00	242.50
1989				
4Q	198.33	204.16	210.00	247.50
3Q	205.00	206.66	209.16	225.83
2Q	183.33	188.33	199.16	218.33
1Q	165.00	177.50	185.00	202.50
1988				
4Q	170.83	186.66	193.33	202.50
3Q	181.66	205.00	233.33	215.00
2Q	176.66	194.16	200.00	200.83
1Q	170.00	183.33	183.33	198.33
1987				
4Q	155.00	165.00	167.50	195.00
3Q	141.66	151.66	158.33	175.00
2Q	133.33	136.66	141.66	168.33
1Q	115.83	116.66	127.50	155.00
1986				
4Q	99.16	94.16	95.00	100.00
3Q	114.17	103.33	91.67	118.33
2Q	92.50	93.00	90.00	97.50
1Q	94.16	92.50	90.00	92.50
Year end				
1985	92.50	92.50	90.00	100.00
1984	146.25	145.00	140.00	147.50
1983	132.50	125.00	109.50	120.00
1982	90.00	100.00	95.00	105.00
1981	137.50	128.50	131.00	146.00
1980	136.50	151.50	140.50	160.50

Note: Prices reflect paper and board mill purchase prices, f.o.b. seller's dock exclusive of delivery charges, and they represent contract rather than spot or premium sales.
Source: *Pulp & Paper Week.*

mer sources. Corrugated collections in 1990 totaled 13.2 million short tons, about 2.3% above the previous year. The 1990 collection rate was about 50%—about the same as the previous year—despite the increase in new recycling programs at hotels, motels, restaurants, fast-food outlets, and airports in recent years.

Mixed papers are generated mostly in office buildings and are collected by private haulers. When demand is poor and prices fall, haulers usually cease picking up mixed papers because, as the cheapest of wastepaper grades, their price drops below a level that makes collection profitable.

High grades of wastepaper are usually obtained from large office buildings, where an agreement is worked out with a paperstock dealer. More corporations and commercial landlords are collecting office papers to reduce their waste disposal costs and to make some additional money from selling the refuse. Usually this is done by having employees sort their own office discards and take them to a central collection point in the building, where the recyclables are subsequently picked up by a private hauler.

Total collection of high grades for deinking and pulp substitutes in 1990 was 6.1 million short tons, up 7.3% from the previous year. Some of this growth is reflected in the increased numbers of office presort programs that are producing a deinking grade of wastepaper. Growth in this category, however, is expected to be limited by the amount of clippings and cuttings generated in factories making paper products such as envelopes, business forms, and printed brochures. Yet demand for the high grades will remain healthy as mills shift more of their fiber furnish requirements from woodpulp to secondary fiber.

More businesses in both the U.S. and Canada, though, are recycling their office waste. These wastepaper grades, like computer printout (CPO) and ledger grades, bring a higher price on the market than ONP. The Office of Paper Recycling Services in New York City estimates that the average office worker produces at least 1 lb/day of wastepaper. In early 1989, API estimated that corporations in the U.S. recycle about 200,000 short tpy of paper compared with virtually nothing ten years ago. Some corporations find that they save money on their trash bill by having recycling plants haul away their paper trash. Paper generated by offices is cleaner than that of homes and is more desirable to packers, who compete for the right to haul away wastepaper from big office buildings.

Recovery and demand for office wastepaper is expected to advance by almost 26%/year through 1995, but both will still lag behind generation of office scrap paper, according to a 1991 report by Franklin Associates for the National Office Paper Recycling Project. Generation of office wastepaper—including printing/writing grades, OCC, and ONP—is projected to grow to almost 9.3 million short tons by 1995 (a 2.5%/year increase); yet, even though recovery and demand will advance by much higher rates than generation, only 36.8% of office wastepaper will be recovered and reused by 1995 (up from 16.5% in 1990.).

GRADES

Mixed papers, news, OCC, pulp substitutes, and deinking are the five official grade categories used by the Dept. of Commerce and generally accepted by the industry as key benchmarks for numerous other grades. The Paper Stock Institute of America (PSI), a division of the Institute of Scrap Recycling Industries, subdivides the five classifications into more definitive grades. These include 51 regular grades that comprise the bulk of the wastepaper traded in the U.S. and Canada, along with 33 specialty grades that

U.S. WASTEPAPER EXPORTS TO MAJOR CONSUMING COUNTRIES, 1990

(short tons)

Country	Printed news	High-grade deinking	High-grade pulp substitutes	Corrugated	Mixed	Total
Rep. Korea	406,975	372,918	63,710	278,319	205,012	1,326,933
Mexico	98,556	49,497	48,040	315,016	322,341	833,450
Taiwan	238,831	176,784	8,314	608,268	14,718	1,046,914
Japan	49,802	49,631	29,375	477,994	148,738	755,540
Canada	742	314	20,308	357,085	274,755	653,203
Italy	21,540	22,884	5,395	61,701	49,468	160,988
Spain	6,991	27,722	3,695	104,858	41,454	184,720
Indonesia	73,213	38,707	949	62,977	23,684	199,530
Philippines	46,772	44,673	2,723	27,142	18,569	139,879
Subtotal	**870,207**	**744,422**	**181,559**	**2,230,383**	**1,075,056**	**5,301,156**
Other	145,561	232,892	59,322	500,397	394,655	1,332,825
Total exports	1,015,768	977,314	240,881	2,730,780	1,469,711	6,434,451

Source: Dept. of Commerce.

are sold to a limited number of mills able to use them in their product mixes. The specialty grades generally include contaminants, such as plastic coatings and foil, which restrict their use. Grade characteristics are as follows:

- Mixed paper: paper of varied quality, often office waste; also boxboard cuttings and mill wrappers
- News: ONP, either collected from households or overissues at newsstands or inplant; also groundwood paper trim
- OCC: used corrugated containers; also container plant cuttings
- Pulp substitutes: unprinted grades of brown and colored kraft, white and semibleached sheets and cuttings, tabulating cards, and shavings or trim of unprinted grades
- Deinking: deinking grades of white and colored ledger, CPO, coated book and groundwood paper, and bleached sulfate sheets and cuttings.

Definitions. With increased government involvement in recycling, various definitions of recycled fiber and recyclable products have been used in proposed bills, adopted laws, and negotiated agreements. This has led to much confusion about how to label products and fibers to qualify as recycled.

PSI uses the term "paperstock" and defines it as "fiber used for repulping," with further elaboration in its "Scrap Specifications Circular 1990," which includes classifications for 51 regular and 33 specialty grades of paperstock. PSI additionally uses the term "recycled good," meaning "any material or good remanufactured using material diverted or separated from solid waste disposal or sold or distributed in interstate commerce, or reused as a direct substitute for other goods sold or distributed in interstate commerce."

API has a set of its own terms. Recyclable paper, for instance, means "paper separated at its point of discard or from the solid waste stream for use as a raw material in the manufacture of a new product...often called wastepaper or paperstock." API further describes wastepaper as "any paper or paper product that has lost its value from its original purpose and has been discarded, including any waste or scrap generated from paper converting operations, such as printing plant waste and envelope cuttings, as well as discarded products such as boxes or newspapers."

EPA, on the other hand, makes a distinction between materials recovered from the solid waste stream and those recovered within a manufacturing operation. This has been at the root of the disagreement between EPA and the paper industry. The paper industry, as noted earlier, claims that preconsumer waste reclaimed from the manufacturing process would otherwise end up in the solid waste stream. But EPA wants only postconsumer waste included in products labeled recycled.

Two groups, ASTM and RAC, are separately working to reach a consensus on recycling definitions. ASTM was asked by several state governments to head up committees that would meet to hammer out an agreement on terms. RAC was formed by NRC with an EPA grant. Each group has come up with its own definitions and standards. In effect, though, neither's actions will be accepted as the consensus until they are approved by EPA.

MARKETS

Markets for the various grade classifications of wastepaper are essentially different, although there is some crossover in the types of paper and board made from different furnishes. For example, clay-coated newsback can incorporate OCC, ONP, and pulp substitutes.

U.S. WASTEPAPER EXPORTS, 1970-90

(short tons)

Year	News	Corrugated	High-grade deinking	High-grade pulp substitutes	Other	Total
1990	1,015,768	2,730,779	977,313	240,881	1,469,710	6,434,451
1989	829,455	2,695,543	812,043	401,549	1,340,570	6,079,161
1988	1,008,664	2,277,166	841,696	627,757	884,835	5,640,118
1987	869,743	1,920,719	525,860	365,419	736,691	4,418,432
1986	765,832	1,524,897	446,966	312,239	674,940	3,724,874
1985	624,644	1,310,852	290,486	178,975	879,042	3,283,999
1984	540,459	1,263,043	296,274	251,200	917,201	3,268,177
1983	461,153	993,436	224,701	189,578	750,463	2,393,381
1982	444,093	886,655	140,349	163,790	492,131	2,127,018
1981	425,060	991,115	130,319	192,192	473,863	2,212,549
1980	424,864	1,208,609	176,442	204,881	649,395	2,664,191
1979	336,138	960,369	134,959	153,950	647,686	2,233,102
1978	366,005	576,653	93,307	92,452	471,032	1,599,449
1977	644,038	591,529	301,273[1]	—	341,526	1,878,366[2]
1976	244,118	426,104	300,096[1]	—	302,418	1,272,626
1975	164,294	333,631	176,145[1]	—	187,318	861,388
1974[3]	—	—	—	—	—	1,307,000
1973[3]	—	—	—	—	—	683,444
1972[3]	—	—	—	—	—	415,033
1971[3]	—	—	—	—	—	419,046
1970[3]	—	—	—	—	—	408,000

1. Includes "high-grade pulp substitutes."
2. Subsequent revision by Census changed total to 1,544,000 tons, due to errors reported in exports to Greece and Canada; revision does not indicate which wastepaper grades are affected by the change.
3. No grade designations prior to 1975.

Source: Dept. of Commerce.

Mixed papers, the cheapest grade of paperstock, are used in construction paper and paperboard products such as roofing felts and gypsum wallboard. A shift from paper-based roofing to fiberglass-based shingles has cut demand substantially for mixed papers in this market. In addition, the construction business has not been robust in recent years, with U.S. housing starts dropping overall since 1983.

Demand for OCC, mainly from linerboard and corrugating medium mills, has risen dramatically in recent years. Between 1980 and 1990, U.S. mills increased their usage of OCC (as well as new double-lined kraft corrugated clippings) by 56%. This growth in secondary fiber demand was paced by advances in paper machine technology and contaminant removal systems (see chapters on Linerboard and Corrugating Medium). These developments have kept OCC prices more resistant to fluctuations in the market. During first-half 1991, prices for many grades of paperstock plummeted, while OCC prices actually rose. Between June 1990 and June 1991, the average U.S. price for OCC was up 18.8%, according to *Paper Recycler* newsletter.

ONP prices also advanced in 1991 from their depressed levels of 1990 as more new deinking plants started up in the U.S. and Canada. Several more new deinking operations will be starting up in the coming year, raising demand for ONP even further. However, mandatory source-separation and collection laws continue to proliferate, adding even more to the supply of ONP than demand can absorb. Mills in the Northeast, for instance, continue to charge as much as $10/short ton to take ONP. Municipalities would rather pay this than the much higher landfill tipping fees; also, they are increasingly being mandated to recycle more waste, and various products are being banned from landfills.

In June 1991, the average transaction price for ONP in U.S. domestic markets was $17.50/short ton, compared with $13.75 a year earlier. The transaction price of ONP, however, is often hard to determine because mills usually keep prices at artificially inflated levels so that those who make a living packing and sorting ONP can stay in business. Essentially, due to the overabundance of ONP, the real market value of this postconsumer paperstock is zero. Because more and more ONP is being collected by subsidized public programs, price could drop; in any event, any increases will be impeded by the growth in supply.

While the low grades rebounded from their fall in 1989 and 1990, the high grades continued to drop in 1991. The pulp substitutes were hurt by discounting in woodpulp, which made woodpulp more attractive to purchase—especially for overseas customers—than pulp substitutes. Deinking grades, on the other hand, were undermined by rising supplies from increased office collection programs.

Normally, high grades suffer least during fluctuations in market conditions. With the inexorable increase in market pulp prices during 1987-88, many mills stepped up their use of pulp substitutes, such as hard white envelope cuttings and hard white shavings (HWS). When the price of pulp substitutes became too high, mills that could traded down to deinking grades, such as CPO, manifold white ledger, and manifold colored ledger.

However, with the fall of the woodpulp market from late 1989 through 1991, pulp substitute prices also began to tumble. In most regions of the country, prices have dropped each month for about two years. For instance, from June 1989 to June 1991, HWS prices plunged about 42% in New York, N.Y., 46% in Chicago, Ill., 42% in Atlanta, Ga., and 45% in San Francisco and Los Angeles, Calif.

Deinking grades exhibited the strongest demand of any grade of paperstock in 1989, but demand dropped slightly in 1990. As technology improves, more mills are downgrading to lower grades of wastepaper—in some cases, making up their own grades of office papers. One grade gaining popularity in 1990 was laser-free CPO because it is the only postconsumer deinking grade that can be used as a direct pulp substitute.

Laser CPO markets have been one of the most challenging in recent years, though. With the growth in laser printers, fewer mills are able to use CPO with laser printing. Laser printers burn ink into the paper, making deinking difficult with conventional flotation and chemical processes. Some companies claim to have developed methods for dealing with laser-printed CPO, but they keep the details classified. Kimberly-Clark Corp. operates a pilot plant for this purpose at its tissue mill in Memphis, Tenn., but the company will not discuss the project. Industry sources believe Fort Howard Corp. also has such technology in place.

In the secondary fiber business, technology provides an important edge. Mills that can remove certain contaminants, such as hotmelt glues and laser printing, can use a wider variety of paperstock grades and hedge fluctuations in supply/demand and prices. In addition, they can make a higher-quality product using lower-cost raw material.

Contrary to other sectors of the pulp, paper, and paperboard industry, the consumer of wastepaper usually sets the price. When mills want to generate more paperstock due to projected shortfalls in supplies, they raise prices and cause generators to take interest in the market again. Conversely, prices are cut when the intention is to slow the flow.

The exception occurs during a shortage, when demand picks up faster than additional supplies can be generated. This does not happen often, however, since mills have become increasingly more adept at spotting upcoming changes in the marketplace. In addition, more primary producers are themselves getting involved in recycling, integrating their operations fully or partially to eliminate or reduce the need for a intermediate agent, such as a dealer or broker of paperstock.

Secondary fiber prices react quickly to changes in the entire industry and, as such, are considered a bellwether of future market conditions. Most industry experts think wastepaper prices will continue to vacillate suddenly and sharply unless supplies are substantially reduced by construction of waste-to-energy facilities throughout the country or by other methods that would limit supplies.

EXPORTS/IMPORTS

The U.S. is by far the world's largest exporter of wastepaper. In 1990, U.S. paperstock exports reached an all-time high of 6.5 million short tons—a 3.1% increase over 1989, according to API (Dept. of Commerce figures indicate exports totaled 6.434 million short tons). Wastepaper imports into the U.S. are relatively insignificant. In 1990, the U.S. imported just 122,539 tons of wastepaper.

The largest consumers of U.S. paperstock in 1990 were Rep. Korea, 1.327 million short tons; Taiwan, 1.047 million tons; Mexico, 833,450 tons; Japan, 755,540 tons; Canada, 653,203 tons; Indonesia, 199,530 tons; Spain, 184,720 tons; Italy, 160,988 tons; and the Phillipines, 139,879, according to Dept. of Commerce data. Excluding Indonesia, the eight remaining countries accounted for 87.7% of U.S. wastepaper exports in 1987, 84.7% in 1988, 80.6% in 1989, and 79.3% in 1990 (82.4% in 1990, with Indonesia included). The declining importance of the largest importers of U.S. wastepaper suggests that the world market for U.S. wastepaper has been broadening, according to API.

U.S. wastepaper exports have grown rapidly during the past two decades, rising from 408,000 short tons in 1970. Aside from the record reached in 1986, each of the years after 1982 marked all-time highs. In 1982, however, exports dipped 3.8% due to a worldwide recession but rebounded by 12.5% in 1983 to 2.393 million short tons.

The strongest gain in U.S. wastepaper exports in 1990 was registered by mixed papers, growing by 34.3% to 1.1 million short tons, according to API. Newspapers were down a slight 1.9% to 1.2 million tons, and OCC, a category that also includes unbleached paper and paperboard, dropped by 6.4% to 2.7 million tons. Declines were also registered in the high grades, with high-grade deinking papers and pulp substitutes dropping by 9.4%. Stronger domestic demand for ONP and OCC grades may have resulted in smaller volumes being available for exports, but the drop-off in high-grade exports was probably caused by a combination of ocean shipping container shortages and overseas buyers switching to heavily discounted woodpulp.

Global demand for U.S. wastepaper should continue to grow. Not only is the relative high quality of U.S. long-fiber wastepaper an attraction but also recovery rates around the world are already reaching their limits while recycled-fiber capacity continues to grow. API projects that world demand for U.S. wastepaper could reach 11 million tons or more by 1995.

CANADA'S TRADE AND USE

Canada remains one of the top five export customers for U.S. paperstock, but its ranking has dropped from second to fourth place since 1980. It is still the chief supplier of U.S. imported wastepaper; however, the import market meets less than 1% of U.S. mills' secondary fiber requirements. Canada, on the other hand, represents about 10% of the export market for U.S. paperstock. The U.S. exported 653,200 short tons of wastepaper to Canada in 1990, according to API.

Canadian mills have increased their use of recycled fiber, and that trend will continue through the 1990s. Canadian recyclable paper consumption rose steadily between 1975 and 1990 to nearly 1.8 million metric tons, according to CPPA. Of this amount, 940,920 tons were container grades, 419,418 tons were pulp substitutes and other grades, 230,970 tons were news grades, 107,810 tons were mixed papers, and 88,159 tons were boxboard cuttings.

In a 1990 study done by Hatch Associates Ltd. for Forestry Canada and Environment Canada, it was found that

CANADIAN WASTEPAPER CONSUMPTION

(metric tons)

Year	Container	News	Boxboard cuttings	Mixed papers	Pulp substitutes and other grades	Total
1990	948,325	306,913	82,966	102,852	409,577	1,850,633
1989	940,920	230,970	88,159	107,810	419,418	1,787,277
1988	924,081	289,970	84,596	120,616	391,453	1,810,716
1987	905,058	239,024	67,227	121,073	363,282	1,695,664
1986	863,954	203,209	72,270	109,690	346,094	1,595,217
1985	752,499	199,883	73,156	94,326	322,485	1,442,349
1984	750,033	206,232	82,603	101,115	323,485	1,463,468
1983	673,828	197,597	78,998	88,773	291,533	1,330,729
1982	606,680	158,188	72,045	60,959	251,928	1,149,800
1981	688,843	150,362	78,991	59,090	232,727	1,210,013
1980	670,385	151,707	79,488	60,943	229,698	1,192,221
1979	613,176	151,613	83,183	74,184	239,339	1,161,495
1978	579,762	120,618	74,016	75,169	231,942	1,081,507
1977	507,437	91,885	62,521	54,793	183,428	900,064
1976	432,945	80,747	60,750	43,123	161,522	779,087
1975	326,951	66,218	52,250	49,738	114,783	609,940

Source: Canadian Pulp & Paper Assn.

Canada's recovery of wastepaper was just 23.3% and its utilization rate was only 11.4%. The low cost of Canadian virgin fiber and energy, the relative distance between recyclable fiber sources and producing mills, and the historical inability to produce a recycled product comparable with a virgin-fiber product have all contributed to low Canadian recycled fiber usage, according to the Hatch report.

Commercially driven demand for ONP in Canada has been limited to Quebec & Ontario Paper Co., which uses ONP to make 50% recycled-fiber newsprint at its mill in Thorold, Ont. However, ONP as well as old magazine demand has picked up since the startup of a new 100% recycled-fiber newsprint machine at Atlantic Newsprint Co.'s mill in Whitby, Ont., in January 1991.

Recycling, though, is more extensive in other sectors of the Canadian paper industry. Fifty-two of the country's 110 mills use wastepaper for all or part of their furnish, according to CPPA. Most of these are located in the densely populated London, Ont., to Quebec City, Que., corridor. They use a variety of wastepaper grades to produce boxboard, tissue paper, containerboard, and some newsprint and printing/writing grades.

Further expansions will increase demand for recycled fiber. Both in the U.S. and Canada, virtually every manufacturer has looked at the feasibility of increasing recycled-fiber production. Most are deciding to add recycled-fiber processing facilities to existing mills where it is more practical. Very few are building greenfield recycled mills.

Some, though, are being more conservative. These are choosing to buy recycled fiber from existing market deinked pulp mills, like those operated by Ponderosa Fibers of America Inc. and Cascades Inc. Or they are opting to sign long-term supply agreements with new mills being planned by others. Fletcher Challenge Canada Ltd. and MacMillan Bloedel Ltd., for instance, plan to buy deinked pulp from a new mill being built in Coquitlam, B.C., by Newstech Recycling Inc.

By the end of 1991, Canadian mills will be able to supply significant volumes of recycled-content newsprint, according to Brian McClay, director of trade affairs for CPPA. Increased recycling activity is also anticipated in other sectors of the Canadian paper industry, such as printing and writing grades. CPPA estimates that the Canadian paper industry's demand for wastepaper will rise to 3.3 million metric tons in 1993, an 83.3% growth in just three years.

RESTRUCTURING

As a result of all the emphasis on recycling and increased recycled-fiber production, the wastepaper business itself is consolidating into bigger operations. Some of these can now accomplish everything from garbage pickup, through paperstock buying and selling, to the production of recycled paper and paperboard. This trend has surfaced just since 1989 and many expect it to continue.

More and more paper companies began in 1989 to look for long-term supplies as uncertainty about adequate recycled fiber availability came into question with the plethora of announced recycled paper and paperboard expansions. They began to sign long-term agreements with paperstock dealers and brokers and then to integrate their supply lines further back to the source—as far as the garbage itself.

In July 1990, Stone Container Corp. announced it had struck a deal with Waste Management of North America Inc., the largest waste hauler in the U.S., to form a joint-

U.S. WASTEPAPER RECOVERY, BY GRADE

(000 short tons)

Year	Mixed papers	Old newspapers	Old corrugated containers	Pulp substitutes	High-grade deinking	Total
1990p	3,669.1	5,830.0	13,450.5	3,097.3	2,880.0	28,926.9
1989	3,139.3	5,390.6	12,884.5	2,973.8	2,688.4	27,076.6
1988	2,908.4	4,754.7	12,378.7	3,582.8	2,554.2	26,178.8
1987	2,776.0	4,493.2	11,298.0	3,354.6	2,111.0	24,032.8
1986	2,682.8	4,287.7	10,364.4	3,149.0	2,037.0	22,520.9
1985	2,711.7	3,864.6	9,361.5	2,715.1	1,715.6	20,368.5
1984	2,732.0	3,773.6	9,363.7	2,969.2	1,691.1	20,529.6
1983	2,478.6	3,478.2	8,534.9	2,674.7	1,560.1	18,726.5
1982	2,104.6	3,410.6	7,771.0	2,421.6	1,370.5	17,078.3
1981	2,575.9	3,286.8	8,000.9	2,505.8	1,350.3	17,719.7
1980	2,744.9	3,301.9	8,117.8	2,457.3	1,321.3	17,943.2
1979	3,114.6	3,173.4	7,918.0	2,461.1	1,251.5	17,918.6
1978	3,059.9	2,873.8	7,336.9	2,358.8	1,175.5	16,804.9
1977	3,114.5	3,200.9	6,766.5	2,322.5	n.a.	n.a.

p = Preliminary.
n.a. = Not available.
Source: American Paper Institute.

venture wastepaper marketing company. Paper Recycling International was the result. PRI brokers the paper that Waste Management collects, selling it to Stone and others. Earlier in 1990, Waste Management acquired U.S. Recycling Industries, a large U.S. wastepaper collector, sorter, and baler.

In June 1990, Weyerhaeuser Co. signed an agreement with Browning-Ferris Industries, the second largest waste hauler in the U.S., to provide Weyco's Secondary Fiber Div. with about 120,000 short tpy of recycled fiber. Among other companies that have made similar arrangements is Canadian Pacific Forest Products Ltd. with Laidlaw Waste Systems Inc., a large Canadian garbage collector.

Paper companies have been integrating more into the paperstock business since the late 1980s but never as quickly as in the early 1990s. Jefferson Smurfit Corp. has operated its own secondary fiber procurement division for several years. The operation, which was recently restructured and renamed Smurfit Recycling Co., claims to be the largest reclamation and recovery operation in the U.S., collecting approximately 4 million tons of wastepaper in 1990 for use in its own mills or resale to other domestic and overseas consumers.

Other North American paper companies that handle their own recycled-fiber procurement and marketing divisions include Cascades Inc., Domtar Inc., Garden State Paper Co., Quebec & Ontario, Sonoco Products Co., Southeast Paper Manufacturing Co., and The Newark Group Inc.

The Newark Group has also been an aggressive acquisitor in the past year. Late in 1990, it purchased Garden State Paper's Great Eastern Packing & Paperstock Corp. This extended Newark Group's Recycled Fibers Div. to 21 locations across the U.S. The company consumes approximately 2 million short tpy of recovered paper at its 11 mills coast to coast. In addition, its Recycled Fibers Div. purchases about 2 million short tpy for domestic and export sales outside the company.

Wastepaper dealers and brokers—which have long been the backbone of the wastepaper collection and distribution business—are concerned that these new deals could put them out of business. In addition, municipalities themselves are setting up programs to market their recyclables, and mills are finding it cheaper to bypass the dealers and brokers and go directly to these government agencies.

However, other market observers feel confident that brokers and dealers will still have a place in the market, especially for the higher grades, such as pulp substitutes and deinking grades, that municipalities and waste haulers find more difficult and less profitable to handle with a large-scale, commodity-oriented approach.

MILL PROCESSING

The recycling of wastepaper involves the return of all types of paper or discarded papers back to the paper mill for the manufacture of new products. The types of equipment used and the design of the mill recycling process are closely correlated to the types of wastepaper used and the various kinds of finished paper produced. For example, Stone Container's Snowflake, Ariz., plant has flotation deinking equipment that allows the mill to use 30% old magazines/70% ONP as fiber sources. Garden State Paper in Garfield, N.J., adds 100% ONP to its process, which features washing deinking equipment. Both mills make top-quality newsprint from 100% recycled fibers; however, the wastepaper purchased is dictated by the differing process designs of each mill.

The heart of the recycling process is the stock preparation operation, which involves pulping, contaminant removal, and chemical application to prepare the recovered fibers for the papermaking process. Pulping and contaminant removal equipment are fairly similar in most mills, but chemistries and process designs differ depending on the grade of paper being produced, the level of quality being considered for the finished paper, and the technology available to the mill at the time.

Pulping. Wastepaper pulping is significantly less complex than pulping wood. It involves the mechanical separation of the paper sheet into individual fibers.

A pulper is generally used in pulping secondary fiber. Water and wastepaper are added from a conveyor belt or by forklift to the pulper until a desired fiber to water ratio is reached. Consistencies can range anywhere from 3% to 16% fiber depending on the operational design of the mill. A spinning rotor in the bottom of the pulper tears the paper into smaller pieces. These pieces rub against each other to further break down and separate the fibers from each other. Stock removed from the pulper usually passes through additional screening and trash removal equipment to remove pieces that have not been broken down sufficiently.

Chemically treated or coated wastepaper, which may be more difficult to repulp, requires further processing. Usually the water in the pulper is heated to 65°C (150°F), and chemicals such as sodium hydroxide or soaps and dispersing agents are added.

Contaminant removal. Contaminants cause problems to the recycled papermaking process that can effect finished paper quality and machine runability. Heavy contaminants include metals (nuts, bolts, wire, soda cans, and staples) as well as sand, rocks, and glass. Light contaminants include plastics, styrofoam, waxes, hotmelt glues and adhesives, pressure-sensitive adhesives (stickies), and wood (from skids). Ink is a common contaminant found on paper and is also difficult to separate and remove from paper fibers. Ink removal is considered a separate process called deinking.

Contaminant-removal systems are usually designed so that the larger contaminants are removed first. This gets them out of the system before they are broken down into smaller particles that will be more difficult to remove. With a properly designed contaminant-removal system, 99% or more of the debris found in grades such as OCC can be removed.

Pieces of equipment used in such a system include the following:

- Pulper—used to slush up the incoming bales of OCC. This eliminates larger contaminants as they pass through an extraction plate with $^{1}/_{2}$-in. or $^{5}/_{8}$-in. drilled holes.
- Pulper washing systems—these detrashing systems

continuously remove large debris so that the pulper remains unclogged.

- Centrifugal cleaners—remove contaminants by centrifugal action using a specific gravity that is based on the contaminant. This can range from high-density cleaners used to remove nuts and bolts to through-flow cleaners used to remove small pieces of plastic, stickies, and waxes.
- Screens—use either holes or slots to separate the good fiber from the contaminants and are usually installed in multiple stages to prevent excessive loss of good fiber. A typical arrangement would be a combination of coarse screens for larger pieces of debris (holes range from 0.050 to 0.094 in.) and fine screens for small pieces of plastic and stickies that have passed through the coarse screens (slots range from 0.008 to 0.014 in.).
- Dispersion equipment—used to break up the remaining debris so that it can be hidden in the sheet.

Deinking. In the deinking operation, ink is removed from the fiber by combination of mechanical and chemical action. Washing or flotation systems are used to remove the ink once it is in suspension. A deinking plant at a mill would consist of a combination of contaminant removal equipment, as mentioned, along with washing and/or flotation equipment.

With ink particle size below 10 microns and/or with high-ash-content furnishes, washing offers the highest efficiency. However, with the evolution in laser printing, printing-xerography, and UV-cured inks, flotation deinking systems are being used more now in North America. And where both ink and ash removal are required, a combination washing and flotation system is advised.

One advantage of washing systems is in deinking waste-based flexographic inks. This type of ink disperses readily, to a point where some of the ink particles are so small that they cannot easily be separated from the pulp fibers.

The chemistry in each system differs. Washing requires a dispersion approach, and flotation requires a collector approach. Dispersion and collector chemistries are quite different. Fortunately, chemical suppliers have developed chemical formulas balancing the needs of both, and suppliers continue to improve methods of washing and flotation.

Flotation is a process whereby air is injected into the system, creating bubbles that capture the ink particle and rise to the pulp slurry surface as foam. The foam is skimmed off the top, removing the ink with it.

Dispersion devices have been developed that, with a combination of thermal and mechanical energy, break residual ink or stickie contaminants down to ultrafine particle size. Dispersion tends to create lower brightness levels but creates a uniform overall appearance to the sheet. Particle size of the stickies becomes small enough to greatly reduce the chance of plugging machine forming fabrics. Wet-end chemistry helps to prevent these particles from adhering to each other.

For lower-brightness systems generally involving mechanical pulps, a lower-consistency sodium hydrosulfite bleach stage is often sufficient. Where additional brightness is required, though, a high-consistency bleaching stage is added.

The peroxide stage, followed by a sodium hydrosulfite stage, provides high brightness along with the color stripping capabilities of the hydrosulfite. Other promising bleaching agents include thioureadioxide and formamidinesulfinic acid.

CONVERTED PAPER AND BOARD PRODUCTS

The converting sector produces finished products—corrugated boxes, folding cartons, envelopes, facial tissue, and other products—from paper and paperboard. The average converting plant is small, usually employing fewer than 100 people and annually grossing about $10 million or less. However, the total converting sector of the industry is not so small. In fact, when sales of all converting segments are combined, they nearly equal the total value of all paper and board manufactured. In 1990, total converted products shipments were valued at approximately $72 billion.

Because the converting sector is large and complex, this chapter describes the subject in only a general way. In many cases, it is more practical to discuss converting under the primary manufacturing to which it relates; therefore, the reader is referred to sections covering primary paper or board grades for additional information.

The following converted paper and board products are discussed here and in other specified sections:

- Corrugated containers and solid fiber boxes (refer to Linerboard and Corrugating Medium sections)
- Setup paperboard boxes (Recycled Paperboard section)
- Fiber and composite cans, tubes, and drums (Recycled Paperboard section)
- Folding boxboard (Bleached and Recycled Paperboard section)
- Sanitary food containers (Bleached Board section)
- Sanitary tissue products (Tissue section)
- Molded pulp products (Pulping Processes section)
- Bags and sacks (Packaging and Industrial Converting Papers section)
- Envelopes (Paper Introduction section).

The following converted products, though not discussed in the text, are included in the statistical data in this section:

- Die-cut paper and paperboard
- Coated and laminated paper products
- Packaging tapes and labels
- Sanitary paper products
- Stationery paper products
- Converted paper products, not classified.

Although the printing and publishing industries are not converting industries, they are closely allied to the paper industry; data on these industries are summarized in the introduction to the paper grades section.

CORRUGATED CONTAINERS

Corrugated containers are the workhorses of the packaging industry. More goods and products are shipped in corrugated containers than in any other packaging system. Nearly 90% of industrial and consumer goods transported in the

PACKAGING SALES BY PACKAGING MATERIALS

	Shipments (billion $)	% of total
Total packaging sales	$53.7	100.0%
Paper and paperboard	27.3	50.8
Corrugated containers	15.6	29.1
Folding cartons	5.5	10.2
Paper bag/sacks	2.3	4.3
Sanitary food containers	1.9	3.5
Others	2.0	3.7
Metal	11.3	21.1
Cans	10.3	19.2
Drums and others	1.0	1.9
Other materials	15.1	28.1
Glass	4.5	8.4
Flexible	4.0	7.4
Plastic	3.8	7.1
Wood and textile	0.8	1.5
Others	2.0	3.7

Source: Bureau of the Census, 1987 Census of Manufactures.

U.S. CONVERTED PRODUCTS INDUSTRY VALUE OF SHIPMENTS

(million $)

CONVERTED PAPER PRODUCTS

Year	Total	Sanitary paper products[1]	Bags and sacks[2]	Paper coated, laminated	SIC 2645 Die-cut paper and board	SIC 2679 Miscel-laneous converted products[3]	SIC 2677 Envelopes	SIC 2678 Stationery and tablets	Pressed and molded pulps
1990e	$41,938	$14,079	$8,805	$7,884	$2,000	$4,400	$3,200	$1,300	$260
1989e	40,408	13,089	8,709	7,500	2,000	4,300	3,150	1,400	260
1988e	37,450	12,117	7,945	6,801	1,197	4,150	2,936	1,334	250
1987	33,988	11,698	7,025	5,892	1,749	3,570	2,598	1,216	240
1986	33,200	10,732	5,839	7,100	1,690	2,947	2,230	1,192	270
1985	30,367	10,194	5,542	6,654	1,651	2,873	2,086	1,107	260
1984	29,925	9,772	5,388	6,452	1,880	2,928	2,108	1,161	236
1983	26,563	8,616	5,081	5,314	1,798	2,604	1,875	1,058	217
1982	25,044	8,374	4,773	4,903	1,605	2,436	1,752	959	242
1981	26,111	8,346	5,613	5,146	1,677	2,598	1,601	892	238
1980	23,705	7,636	5,215	4,688	1,454	2,187	1,464	836	225
1979	21,081	6,615	4,579	4,086	1,468	2,043	1,304	766	220
1978	18,447	5,591	3,926	3,746	1,189	1,901	1,121	747	226
1977	16,454	4,921	3,482	3,392	1,058	1,698	991	652	240
1976	12,558	4,187	1,936	2,653	983	1,267	843	510	219
1975	11,086	3,647	1,760	2,198	882	1,107	806	483	203
1974	9,886	3,041	1,913	2,350	884	1,073	813	486	202
1972	7,297	1,982	1,186	1,650	646	662	558	421	162

BOXES AND CONTAINERS

Year	Total	Corrugated containers[4]	Folding boxes	Sanitary food containers	Fiber cans, tubes, drums	Setup paperboard boxes
1990e	$30,182	$18,120	$6,856	$2,825	$1,905	$476
1989e	30,047	18,473	6,594	2,757	1,763	460
1988e	28,365	17,755	6,094	2,447	1,631	438
1987r	25,869	16,107	5,705	2,083	1,537	437
1986	22,505	13,038	4,575	2,806	1,564	522
1985	22,180	12,715	4,452	2,853	1,679	481
1984	21,968	12,719	4,327	2,750	1,679	493
1983	19,906	11,045	3,980	2,686	1,643	552
1982	18,578	10,303	3,744	2,556	1,490	485
1981	18,917	10,760	3,557	2,691	1,496	413
1980	17,193	9,651	3,277	2,430	1,370	465
1979	15,895	8,976	2,950	2,328	1,297	434
1978	14,528	8,030	2,884	2,086	1,119	409
1977	13,350	7,351	2,579	2,048	1,011	361
1976	11,662	6,530	2,162	1,744	1,000	406
1975	10,476	5,733	1,875	1,616	988	344
1974	10,489	5,867	1,807	1,506	909	400
1972	7,913	4,197	1,372	1,381	620	343

e = Estimate.
r = Revised.

[1] Includes drapes, sanitary napkins, tampons.

[2] Includes plastic bags and sacks.

[3] Includes wallcovering, gift wrap, industrial products, novelty items, etc.

[4] Includes solid-fiber containers.

Source: U.S. Debt. of Commerce, "Industrial Outlook" (1991); Bureau of the Census, "Survey of Manufactures" (1987).

U.S. include some form of corrugated or solid-fiber container, cushioning, or partition. Shipping containers represent about 70% of the corrugated industry's products, with the other 30% comprised of printed displays, consumer packaging, cushioning, and slip sheets.

Corrugated containers are produced from two paperboard grades: linerboard and corrugating medium. Corrugated board is produced on a corrugator that simultaneously flutes the corrugating medium and bonds linerboard to the top and bottom of the medium. The corrugator also cuts the board to size and may score it in one direction. Before the blank can be formed into a box, score lines must be added in the other direction and slots must be cut to form flaps that can be folded. This standard box is called a regular slotted container (RSC), and the machine that performs these multiple steps is called a flexo-slotter-folder-gluer.

The most common form of corrugated board is single wall (one layer of medium between two layers of linerboard). About 90% of boxes in the U.S. are made from single-wall board. Corrugators can also produce single face (one layer of medium bonded to a single layer of liner), which is used mainly for wrapping and interior packing. Heavier-duty boxes can be made from double wall (two layers of medium and three linerboard facings) and triple wall (three medium layers and four liner facings).

Flutes have five standard sizes: A, B, C, D, and E. Flute size is determined by the size of the teeth on a corrugating roll and is measured in flutes/linear ft. The larger flutes generally offer greater stacking strength and the smaller flutes greater puncture resistance. Most converting plants produce the intermediate-size B and C flutes. The A flute is the largest, but it is not widely used. E flute is the smallest and is somewhat of a specialty because it can be run on folding carton equipment. It also offers the smoothest printing surface because its closely spaced flutes prevent "washboarding" of the outer liner. E flute is the preferred choice for point-of-purchase retail displays. Choice of flute type depends primarily on strength (crush strength) and packaging requirements.

Corrugated boxes are manufactured in several different styles, the most common of which is the RSC. More specialized types of boxes include bag-in-box for liquids and powdered products, bulk bins that can carry products weighing up to 3,000 lb, and trays for produce. Solid-fiber boxes, the first fiber boxes to replace wood packaging, account for only about 0.4% of industry shipments. Solid-fiber sheets are constructed by gluing or laminating two or more plies of paperboard together. A new and growing solid-fiber application is slip sheets, which are replacing wooden pallets for forklift loads.

Recent trends. Since 1906, corrugated boxes used in interstate shipping in the U.S. have been subject to certain regulations that ensure product protection. In early 1991, major revisions were made to the rail carriers' Uniform Freight Classification-Rule 41 and the National Motor Freight Classification-Item 222. Two key changes were made: 1) the traditional mullen test for box strength was replaced with an edge compression test as the most important measure of box performance and 2) mandatory basis weight requirements for linerboard and medium were eliminated.

The revised rules will permit the use of lighter-weight linerboards in high-compression boxes that are more durable and can be stacked higher. New grades of containerboard will be developed, and more recycled and hardwood fibers will likely be used in the manufacture of containerboard. In the future, the new rules could increase industry shipments on a square-foot basis but could reduce shipments in tons.

U.S. PRICE INDEXES FOR MAJOR CLASSES OF CONVERTED PRODUCTS

(1982 = 100)

Year	Converted paper and paperboard products	Sanitary paper products and stock	Paper bags and shipping sacks	Paper boxes and containers	Composite cans
1990	135.2	135.8	156.0	129.3	151.9
1989	132.0	125.3	155.9	130.3	134.8
1988	125.8	117.2	149.0	125.6	126.7
1987	114.7	109.1	125.9	115.4	117.0
1986	109.4	108.1	116.9	107.8	115.1
1985	108.9	106.6	111.9	108.8	114.7
1984	106.4	103.4	110.5	105.7	110.7
1983	100.4	102.1	99.0	99.5	106.5
1982	100.0	100.0	100.0	100.0	100.0
1981	97.9	98.2	n.a.	97.7	91.4
1980	90.2	91.9	93.6	89.4	84.9
1979	79.4	79.1	83.7	79.1	75.9
1978	70.5	71.7	72.5	69.9	70.3
1977	66.8	66.9	65.2	67.1	65.1
1976	64.3	60.6	62.1	66.0	60.0
1975	61.2	55.0	59.2	63.3	56.1
1974	54.8	44.0	52.6	58.5	48.1
1973	46.0	35.3	45.4	49.9	41.0
1972	43.0	34.2	40.9	46.4	38.8
1971	41.5	33.8	38.0	44.7	37.6
1970	40.8	32.5	40.6	43.3	36.3

n.a. = Not available.
Source: Bureau of Labor Statistics.

Basis weights could decline by 10% to 20% over a five-year period, say industry observers.

Market trends. More than 70% of all corrugated packaging materials are used in the manufacture of shipping containers, and corrugated boxes account for about one-third of the total value of all domestic paper and nonpaper packaging sales. Shipments of corrugated and solid-fiber boxes and related products increased for the fifth consecutive year in 1990. Corrugated box shipments in 1990 were at a record-high 318 billion ft^2, up 1.5% from 1989.

RANKING OF MAJOR U.S. CORRUGATED CONTAINER PRODUCERS BY CAPACITY

	Company	Number of U.S. plants	1990 capacity (billion ft^2)
1.	Stone Container	86	43.0
2.	Packaging Corp. of America[1]	56	30.9
3.	Weyerhaeuser	43	28.3
4.	Smurfit/CCA	49	28.0
5.	International Paper	35	23.0
6.	Georgia-Pacific/GNN[2]	33	21.4
7.	Temple-Inland	31	20.2
8.	Willamette	19	14.0
9.	Union Camp	24	12.0
10.	Gaylord Container	21	11.5
11.	Boise Cascade	22	10.0

1. PCA acquired 19 plants from Georgia-Pacific Corp. and 6 plants from Dixie Container Corp. in 1990-91.
2. G-P acquired Great Northern Nekoosa Corp. in 1990.
Source: *Pulp & Paper* estimates.

Corrugated box shipments during the past decade grew at about a 2.5% average annual rate. The fastest growth was in the Southeast, Southwest, and West; the slowest growth was in the Northeast and Midwest, reflecting the movement of industry to the so-called Sun Belt region. The Southeast's share of total U.S. box shipments increased from about 10.1% in 1960 to 18.7% in 1990, while the Northeast's share dropped from 27.3% to 17.3%. The East Central region also showed a major decline, with its share dropping from 21.4% in 1960 to 14.5% in 1989.

The slower growth in corrugated box shipments in 1990 due to the weakening U.S. economy was instrumental in moderating the steep upward trend in corrugated board prices seen in 1987-88. Frequent regional discounting and price hike rollbacks were implemented under heavy pressure from independent box makers. Due to the slowdown in raw material cost pressures and the weaker economy, box prices declined 5% to 7% in 1990. Inventories at box plants increased about 8%, reaching about 2.8 million tons. Over 90% of this inventory was held at the box plants and the remainder at the board supplier mills.

Industry structure. Corrugated containers are produced at two types of manufacturing plants: corrugated container plants (corrugator plants) and sheet plants. A corrugator plant makes corrugated board on one or more corrugating machines and may make boxes or other finished products from the board. A sheet plant buys corrugated board from a corrugator plant and makes boxes or other finished products from the board.

In 1990, an estimated 1,568 U.S. manufacturing plants were in operation, of which 642 were corrugated converters and 926 were sheet plants. The total number of sheet plants has increased because of their lower capital costs and technical requirements. Also, some corrugator plants were converted exclusively to sheet plants to consolidate manufacturing operations for large producers. In 1990, corrugated plants accounted for about 86% of total corrugated box shipments, and sheet plants accounted for the remainder.

The corrugated container industry is highly integrated with paperboard manufacturing. Vertically integrated manufacturers operate one or more linerboard or corrugating medium mills and one or more corrugator plants. These vertically integrated companies account for about 75% of total U.S. corrugated box shipments. The 1990 merger of Georgia-Pacific Corp.

U.S. CORRUGATED BOX SHIPMENTS BY REGION

(billion ft^2/year)

Year	Total	Northeast	Southeast	East Central	North Central	South Central	West
1990	318.1	55.1	59.4	46.1	39.3	64.1	54.1
1989	313.4	54.9	59.2	44.5	38.5	62.6	53.7
1988	308.5	55.6	57.5	44.5	37.9	61.1	51.9
1987	297.8	54.3	54.8	43.7	35.7	58.5	50.7
1986	283.9	52.3	51.6	41.9	34.5	55.3	48.3
1985	267.5	50.1	48.0	40.3	32.7	52.1	44.3
1984	267.6	51.1	47.5	40.3	32.8	51.4	44.5
1983	252.5	50.3	44.1	37.2	31.3	47.4	42.2
1982	235.2	48.0	39.7	34.3	28.8	44.4	40.0
1981	246.2	50.1	41.7	37.6	30.0	45.2	41.6
1980	241.4	50.6	41.3	36.9	30.1	42.9	39.6
1979	250.6	53.3	41.6	41.1	31.8	43.2	39.7
1978	243.9	52.3	38.8	41.4	31.4	41.8	38.3
1977	227.2	48.3	35.2	39.8	29.6	38.6	35.6
1976	216.4	46.8	32.8	38.3	28.5	36.2	33.8

Source: Fibre Box Assn.

and Great Northern Nekoosa Corp. had a major impact on industry consolidation. The two companies together operate 51 corrugator plants and two sheeting plants that consumed 2.4 million tons of containerboard in 1989 and shipped about 34.2 million ft^2. Georgia-Pacific subsequently sold two containerboard mills and 19 corrugated box plants to Packaging Corp. of America.

Nonintegrated producers generally operate sheet plants, and they depend on integrated producers for their raw materials. Consequently, independent producers are often at a competitive disadvantage, particularly when containerboard is in tight supply. In 1990, however, independents firmly resisted linerboard price increases announced by the major integrated companies.

Although the industry prefers to export semifinished containerboard rather than bulky corrugated containers, exports of corrugated boxes have increased rapidly in recent years. Corrugated box exports climbed an estimated 30% in value to $250 million in the 1989-90 period. Mexico and Canada together account for almost 85% of total U.S. corrugated box exports.

Unlike paperboard mills, which operate continuously, corrugated container plants operate between one and two shifts a day, generally on a five- to six-day week. Production units vary in size, with an average of 94 employees/converting plant and ten employees/sheet plant. They are located close to their markets, principally large industrial and urban centers.

In previous years, the combination of escalating raw material costs and lagging finished box prices squeezed the average box plant's profit margin. This trend forced most box plants to improve productivity, and the results have been dramatic. Weekly shipments per employee have increased steadily from 46,600 ft^2 in 1970 to 85,800 ft^2 in 1989—an 80% productivity improvement.

During this period, the total number of employees in the industry declined from 74,100 in 1970 to a low of 59,100 in the recession year of 1982. Employment returned to 72,200 people in 1989. The improvement in productivity helped control the industry's rise in unit labor costs. Although total hourly payroll costs spiraled upward by 209% during this period, unit labor costs increased only 68%, according to Fibre Box Assn. data.

Productivity improvements resulted primarily from the installation of faster, more efficient corrugators. Other printing and converting equipment improved as well. Flexographic printing and the rotary diecutter were adopted in the 1960s, and the continuous corrugator emerged in the mid-1970s. Today, new state-of-the-art continuous corrugators run at 800 to 1,000 fpm, compared with about 600 fpm for a typical corrugator in the early 1970s.

Such high-speed machines place increasing importance on moisture uniformity, mechanical roll quality, and bonding speed of liners to medium. Moisture variation in container-board may cause warp that high-speed corrugators cannot tolerate, while roll defects may lead to costly downtime from web breaks. Most U.S. containerboard manufacturers are interested in meeting uniform moisture requirements.

Changing market requirements. The trend toward stacking corrugated boxes to greater heights on pallets in warehouses has increased the demand for boxes with greater top-to-bottom compression strength. This trend is being hastened by a shift from rigid metal and glass containers to plastic packaging in primary containers. At the same time, palletization has eliminated much of the manual handling of individual corrugated cases in the transportation system.

As a result, ring crush, which measures compression strength, is replacing bursting strength (mullen) as the most

U.S. CORRUGATED PRODUCTION AND INVENTORY

	Production[1] (billion ft^2)			Inventory[3]	
Year	Single wall	Double and triple wall	Total[2]	Tonnage (000 short tons)	Weeks of supply
1990	310.4	29.4	343.0	2,812	6.6
1989	306.1	28.5	336.3	2,588	5.9
1988	299.3	28.8	329.5	2,486	5.7
1987	289.4	27.6	317.0	2,237	5.8
1986	274.6	26.0	300.5	2,549	7.1
1985	258.9	24.5	283.4	2,882	8.4
1984	256.2	24.7	282.0	2,437	7.2
1983	240.3	22.7	264.2	2,584	8.9
1982	224.2	20.9	246.3	2,729	9.4
1981	229.8	22.1	253.0	1,984	6.2
1980	229.1	21.7	251.9	1,979	6.2
1979	236.7	23.2	261.1	1,961	5.8
1978	232.8	22.3	256.4	2,436	7.2
1977	217.2	20.4	238.8	2,527	8.1
1976	207.9	18.6	227.8	2,185	7.2
1975	186.2	15.9	203.2	2,323	8.2
1974	203.4	19.1	224.1	1,595	4.7
1973	216.8	20.2	238.5	1,603	5.1
1972	200.9	17.6	220.1	1,639	5.7
1971	183.8	15.1	200.3	1,879	7.0
1970	177.1	14.1	192.7	1,760	6.5

1. Production includes waste and trim before fabrication.
2. Total includes single-face production which has averaged around 1.3 to 1.5 billion ft^2/year.
3. Inventory of linerboard, corrugating medium, and filler board at box plants and paperboard mills based on inventory at Jan. 1 of each year.

Source: Fibre Box Assn.

relevant performance requirement for corrugated board (see Linerboard section). Industry pressure for modifications of existing box specifications—from burst strength to compression and edge crush—succeeded in early 1990. A number of producers are now marketing high-performance linerboard that offers higher strength and yield (more surface area/ton) than traditional commodity linerboard.

One method of achieving high compression strength is chemical saturation of containerboard. This has become feasible through the development of new types of saturators using chemicals such as sodium silicate and urea formaldehyde, which can also improve fire and humidity resistance in boxes. International Paper Co., Jefferson Smurfit Corp., and several other companies manufacture such chemically enhanced products. Nekoosa Packaging Corp., among others, also makes a double-laminated corrugating medium with substantially higher crush resistance, bursting strength, and ring crush. Single-wall boxes with the double-laminated medium can be substituted for bulkier, expensive, double-wall boxes. Laminating is done at the corrugator using polyvinyl acetate adhesive.

Improved printing surfaces. Another emerging trend is the use of high-quality printing on corrugated boxes and displays. Direct printing with either flexography or letterpress is used on more than 80% of corrugated products and is one of the least expensive printing methods. The rough surface of the linerboard limits the quality of direct print, however. Preprinting overcomes many of these problems and is now the fastest-growing method. Shipments of preprinted linerboard in 1990 exceeded 6 billion ft^2, according to some estimates, or about 2% of all corrugated product shipments.

During the 1980s, 17 flexographic presses were installed by 14 companies in North America to preprint linerboard. Such preprinted linerboard offers higher-quality graphics than conventional postprinting of corrugated board. It is also less expensive than the higher-quality process of litho-laminating labels. Preprint volume has grown since 1987 because major packagers of consumer goods have increasingly shifted to higher-quality preprint packaging, spurring other companies to do the same.

The growth of preprint has also been helped by the development of more cost-effective board substrates in North America, such as the kraft white-top linerboard introduced by Chesapeake Corp. and the recycled white-top board produced by Green Bay Packaging Corp. The main substrates that are currently being used for preprinting include coated kraft board, solid bleached linerboard, and mottled/unbleached linerboard (see Linerboard section).

SUMMARY OF STATISTICS FOR CORRUGATED AND SOLID-FIBER BOX INDUSTRY

Year	Plants	Employees	Value of shipments (million $)	Capital expenditures (million $)
1990e	1,568	103,000	$18,120	n.a.
1989e	—	105,000	18,473	n.a.
1988e	—	106,000	17,755	$474.0
1987	1,588	105,900	16,107	468.2
1986	—	102,000	13,038	433.5
1985	—	100,000	12,715	420.3
1984	—	98,900	12,719	426.2
1983	—	96,900	11,045	248.1
1982	1,492	93,800	10,303	279.5
1981	—	97,300	10,760	271.2
1980	—	97,200	9,651	420.5
1979	—	103,700	8,976	303.0
1978	—	105,800	8,030	282.5
1977	1,472	101,500	7,351	243.3
1976	—	101,400	6,682	185.1
1975	—	94,700	5,821	207.9
1974	—	106,800	6,015	200.9
1973	—	109,700	5,230	125.0
1972	1,265	107,900	4,309	101.5
1971	—	102,700	3,668	87.5
1970	—	104,700	3,545	108.9
1969	—	105,600	3,500	161.9
1968	—	100,700	3,231	135.6
1967	568	97,100	2,960	127.7

n.a. = Not available.
Source: Bureau of the Census.

Most major U.S. integrated producers now have preprint operations, including Jefferson Smurfit/CCA, International Paper, MacMillan Bloedel Inc., Mead Corp., Menasha Corp., Nekoosa Packaging, Riverwood International, Stone Container Corp., Union Camp Corp., Willamette Inc., Westvaco Corp., and Weyerhaeuser Co. Some integrated producers became involved with preprint operations through acquisitions. For example, Chesapeake purchased the Displayco Group preprint operations from Schiffenhaus Industries in 1989, and it bought Distinctive Printing & Packaging Co. in 1987. Smurfit, in 1989, acquired Tri-Pak Corp., a leading point-of-purchase display manufacturer. Independent converters with preprint operations include Lux Packaging Co., Pioneer Container Corp., and Southern Container Corp. Most litho-laminated containers are produced by independent converters, such as Rand-Whitney Container Corp.

Outlook. A 2.2% average

annual growth rate is forecast for the dollar value of corrugated container shipments over the next five years, according to the U.S. Dept. of Commerce (DOC). This growth trend is in line with the forecast growth in constant dollar GNP, but the demand for boxes from industrial and manufacturing operations may be closer to a 1.0% growth level in 1990-91.

Preprinted corrugated containers and displays, with more colors and graphics, will continue to find new markets, particularly in consumer product packaging. Product development efforts will concentrate on laminates, coatings, adhesives, and inks, and further emphasis will be placed on high-compression boxes. Increased use of recycled materials in all phases of box making will increase.

The corrugated industry will see continued development and use of preprinted linerboard; increased use of flexography in color printing; improvements in graphic design; more computerization and automation in all phases of box plant operations; better marketing and distribution methods; modifications of box specifications for compression and burst strength; greater emphasis on high-strength boxes for stacking; increased use of laminated board; improved coatings, adhesives, and inks; and greater use of E-flute board in point-of-purchase displays of shipping containers.

Corrugated boxes will continue to compete for market share with plastic packaging, especially shrink and stretch films used to consolidate or overwrap bundled goods. However, environmental pressures to limit or ban plastic packaging should help fiber-based packaging products to compete. Principal growth markets are expected in shipping containers and displays for consumer electronic goods, paper and allied products, and fresh produce and meats.

Despite high transportation costs, significant real growth is expected in U.S. exports of corrugated products, especially to Canada, Mexico, and the Caribbean Basin. For expanded trade with Mexico, several new box plants are being established on both sides of the border to serve Mexico's growing Maquiladora industry.

FOLDING PAPERBOARD BOXES

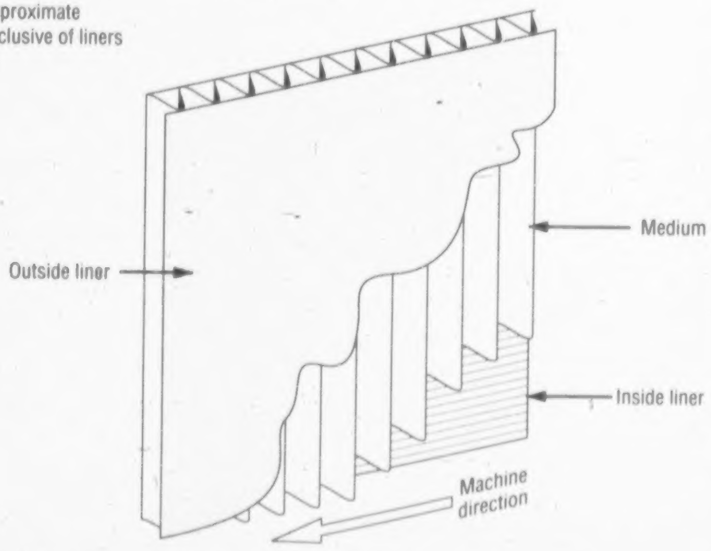
Packaging demand by the U.S. food and beverage industry is the driving force in sales of folding cartons. The country's leading manufacturers of packaged consumer goods use folding cartons to protect their primary product through shipping and distribution channels. Folding cartons are also used to display the product to consumers. They are typically die cut, printed, and shipped flat from folding carton plants to manufacturers, who assemble and fill the cartons on high-speed production lines.

Paperboard grades used for folding cartons must meet technical specifications for scoring, bending, and folding without cracking or breaking; for stiffness and resistance to bulge and surface slack; and for surface smoothness for printing, embossing, or laminating. Paperboard for folding cartons is made in single- and multi-ply grades from woodpulp or recycled wastepaper. The three major paperboard grades for folding cartons are clay-coated newsback (CCNB), solid bleached sulfate (SBS) board, and solid unbleached sulfate folding carton boards; unbleached grades are also called coated natural kraft. Coatings such as kaolin clay, polyethylene, wax, and other special treatments are usually applied to boxboard to im-

COMMON FLUTES USED IN CORRUGATED CONTAINERBOARD PRODUCTION

Flute	Number of flutes[1] per		Flute height[2]	
	Lineal foot	Lineal meter	inch	mm
A	36	118	3/16	4.76
B	51	168	3/32	2.38
C	39-42	128-138	9/64	3.57
E	96	316	3/64	1.19

[1] Approximate
[2] Exclusive of liners



Source: Metrication for the Pulp & Paper Industry, Miller Freeman Publications.

prove strength, moisture resistance, and printing surface smoothness.

SBS has traditionally been the highest-quality grade used by the folding carton industry, preferred for its strength and appearance for packaging wet foods as well as its superior converting and printing for cigarette and cosmetic packaging. CCNB, a recycled grade, represents the largest volume of board used by the folding carton industry for dry foods, soaps, and detergents as well as a wide variety of consumer goods. Unbleached kraft board is used mostly for beverage carriers and multi-pack institutional packaging and has shown the highest growth rate for any boxboard grade during the past ten years.

In 1990, SBS paperboard held a 35% share of the folding carton market, according to the American Paper Institute, the trade association for the primary pulp, paper, and paperboard industry. Recycled boxboard had a 46.4% share, and unbleached kraft board had a 18.7% share.

Domestic folding carton shipments for specific end-use markets generally follow consumer spending and real disposable income levels, but overall carton sales are often unaffected by fluctuations in the nation's economic growth because demand for many basic consumer goods is relatively inelastic. Although the dollar volume of folding carton shipments grew at an average annual rate of about 8% between 1977 and 1990, tonnage volume grew less than 1% annually during this period. Part of the reason is the general trend toward reduced product packaging, the use of lower-density boxboard in the manufacturing process, and carton prices rising faster than volume shipments.

U.S. CORRUGATED BOX PRICE TRENDS

Year	Corrugated shipping containers for food/beverage[1] (Mar. 1980 = 100)	National overall corrugated box price trend[2] (1982 = 100)	
		(1982 = 100)	($/1,000 ft^2)
1990	137.7	120.7	$49.51
1989	147.8	125.8	51.43
1988	143.9	123.3	50.54
1987	128.4	113.3	47.22
1986	116.6	101.6	41.27
1985	119.3	106.1	42.83
1984	115.5	107.3	43.11
1983	106.8	97.2	38.86
1982	108.7	100.0	39.60
1981	108.1	101.8	40.59
1980	100.9	94.2	37.47
1979	n.a.	83.6	33.42
1978	n.a.	74.4	29.65
1977	n.a.	74.5	29.56
1976	n.a.	75.1	29.67
1975	n.a.	73.3	28.82
1974	n.a.	67.8	26.69
1973	n.a.	54.2	21.22
1972	n.a.	47.5	18.59
1971	n.a.	46.1	17.94

n.a. = Not available.
Sources: 1. Bureau of Labor Statistics; 2. Fibre Box Assn.

Folding carton volume has suffered mostly because of competition from alternatives such as flexible packaging, rigid plastic containers, and E-flute corrugated board—all of which have made inroads into traditional folding carton markets during the past decade. For example, many brands of laundry detergent and disposable diapers switched to plastic packaging during the past five years, but there has been some consumer backlash against plastics in the last few years over environmental concerns. The folding carton industry has continued growing because of new product introductions, especially those related to food. Food packaging accounts for approximately one-half of all folding carton shipments.

Market trends. The folding carton industry used about 3.8 million tons of folding boxboard in 1990, according to DOC and the Paperboard Packaging Council (PPC), the trade association representing the folding carton sector. In 1990, shipments of folding cartons totaled approximately 3.1 million short tons, while carton prices increased about 6%. In 1990, shipments of folding cartons to several end-use markets increased significantly. These markets included dry foods, beverage carriers, paper goods, tobacco, soaps and detergents, and consumer electronic goods. Shipments declined for cosmetics, toys, apparel goods, and disposable diaper packaging.

A significant discrepancy exists between API, DOC, and PPC concerning the total amount of paperboard used in the folding carton industry. API reports that paper mills produced over 5 million tons of folding boxboard for U.S. consumption in 1990. U.S. mills also produced an additional 1.4 million tons of paperboard for domestic milk cartons, cups, plates, and disposable food-service packaging in 1990 that are not included in the folding carton total. Foreign exports account for another 900,000 tons of boxboard, mostly bleached kraft board for milk cartons. It should be noted that in manufacturing folding cartons, converting plants waste approximately 15% of the boxboard they purchase from mills. At the same time, paper mills report as produc-

LARGEST CANADIAN CORRUGATED BOX PRODUCERS IN CAPACITY

Company	Number of Canadian plants	Annual capacity (million ft^2)
MacMillan-Bathurst[1]	13	8,280
Domtar	13	6,480
Canadian Pacific Forest Products	7	3,420
Atlantic Packaging	4	2,580
Kruger	3	1,920
Crown Forest	2	1,416

1. Joint venture between MacMillan Bloedel and Stone-Consolidated.
Source: *Canadian Paper Analyst.*

tion some of the roll trim and rejects sold to wastepaper brokers. The remainder of the discrepancy is related to product definitions.

Outlook. At the start of 1990, an estimated 490 folding carton plants were operating in the U.S., down from about 500 at the beginning of 1988, reports DOC. The number of plants has gradually declined during the past several years as less efficient and less profitable plants have been phased out and merger activity has increased. The largest concentration of plants is located in the Great Lakes and Middle Atlantic regions. Industry growth has been the highest in the West and Southeast, however. About 16% of the plants are vertically integrated with board mills.

The folding carton industry has made a number of manufacturing improvements to increase productivity. With customers demanding just-in-time deliveries and shorter production runs, carton manufacturers have had to adopt new techniques, notably high-speed web offset presses. Traditional sheetfed presses offer a variable size format suitable for handling a wide variety of finished product sizes with short runs of 50,000 or fewer cartons. But sheetfed presses require more labor input and more setup time between print runs. Also, productivity is reduced by slow inline cutting and creasing equipment.

To overcome these barriers, many converters have recently installed new web presses, which historically have been associated with medium and long runs of 100,000 or more cartons. The new press systems have been installed by International Paper, Jefferson Smurfit, James River Corp., Westvaco, Shorewood Packaging, and Tetra-Pak Inc., among others, at their liquid packaging or folding carton plants. The trend is forecast to continue, with an average of six new web offset lines being installed each year.

During 1991-95, DOC forecasts that folding carton shipments should increase about 1.2% in dollar volume/year. But the apparently small annual increase is not a true indication of the industry's real growth because steadily improving technology has enabled the folding carton industry to produce lower-density, lighter-weight, stronger cartons, using less boxboard. Improvements are also expected to continue in carton design and graphics, coatings, inks, and other aspects of carton manufacturing.

Most industry observers agree that overall folding carton sales can be increased in only two ways: increase the sales of established products or introduce new products (or entire new product lines) where none existed before. Most growth in folding cartons will come from the basic food packaging markets, but examples of new product lines include packaging for microwaveable food products, computer software, videocassettes, and audio compact discs.

Exports have not been a major factor in the folding carton industry, accounting for less than 1% of total industry shipments. The high cost of transporting bulky, empty cartons over long distances virtually precludes exports, except for nearby markets along the borders with Canada and Mexico. These two countries together account for some 85% of total U.S. folding carton exports. And some additional growth can be expected in these markets as trade flows increase.

SETUP PAPERBOARD BOXES

These specialty boxes are custom made for specific products that require good protection and high-quality appearance. The containers are produced in rigid form, in contrast to folding or collapsible boxes. They are produced from solid or combination board—also called nonbending chipboard, depending on the style of the container. Setup boards range in thickness from 16 pt to 65 pt and have basis weights ranging from 60 to 260 lb/1,000 ft^2.

Stiffness, rigidity, and strength are essential qualities. Rigid boxboard can be made from plain chipboard, filled news board, single new vat-lined chipboard, or single white vat-lined chipboard. Setup paperboard is usually made from a cheaper grade of wastepaper than folding cartons because it is not subject to scoring and bending. Also, the finished surface is typically overwrapped with a specialty packaging paper, so color and appearance are often not important.

After a decline in shipments of more than 5% annually between 1962 and 1982, the industry grew a modest 1.5%/year between 1983 and 1989. In 1990, industry shipments were valued at $476 million by DOC, and an estimated 295,000 tons of mostly recycled boxboard was used in the

EDGE CRUSH SPECIFICATIONS FOR CORRUGATED BOXES

Minimum Edge Crush Test (ECT) (lb/in. width)	Maxiumum weight of box and contents (lb)	Maximum outside dimensions, length, width, and depth added (in.)
Single-wall corrugated fiberboard boxes		
23	20	40
26	35	50
29	50	60
32	65	75
40	80	85
44	95	95
55	120	105
Double-wall corrugated fiberboard boxes		
42	80	85
48	100	95
51	120	105
61	140	110
71	160	115
82	180	120
Triple-wall corrugated fiberboard boxes		
67	240	110
80	260	115
90	280	120
112	300	125

Source: National Motor Freight Classification Committee

DISTRIBUTION OF PAPER/PAPERBOARD PRODUCTS TO MAJOR CUSTOMERS

Paperboard containers and boxes	**% of total dollar output**	**Paper and allied products***	**% of total dollar output**
Food	31.2%	Printing and publishing	23.1%
Wholesale and retail	5.4	Paper and allied products	17.9
Drugs, cleaning, etc.	5.0	Paperboard containers and boxes	12.4
Paper and allied products	4.8	Wholesale and retail	5.1
Eating and drinking places	4.6	Food	5.0
Rubber and miscellaneous plastic products	4.1	Health, education, and social services	2.5
Paperboard containers and boxes	3.6	New construction	1.5
Glass and glass products	2.6	Chemical and chemical products	1.3
Miscellaneous manufacturing	2.3	Rubber and miscellaneous plastic products	1.1
Other fabricated metal products	2.1	Business services	1.1
Other intermediate	30.3	Other intermediate	11.8
Total intermediate	96.0	Total intermediate	82.8
Purchases by individuals	1.4	Purchases by individuals	15.5
Government purchases	1.1	Government purchases	3.4
Exports	1.4	Exports	5.8
Imports	-0.5	Imports	-9.4
Other final demand	0.6	Other final demand	1.9
Total final demand	4.0	Total final demand	17.2
Total intermediate and final demand	100.0	Total intermediate and final demand	100.0

*Excludes paperboard containers and boxes.
Source: Dept. of Commerce, 1983 Input/Output Tables.

FOLDING PAPERBOARD BOX SHIPMENTS BY END USE

(million $)

	1990	**1989**	**1988**	**1982**	**1977**
Wet food and frozen (including ice cream)	$664.2	$645.4	$568.8	$409.5	$311.2
Dry food and produce (including pet food)	883.6	788.3	677.9	544.2	376.4
Bottled and canned beverages (including carriers)	559.2	485.7	443.8	375.0	232.0
Soaps and detergents	273.1	224.1	209.9	205.5	143.8
Tobacco	182.9	164.0	148.2	131.7	93.7
Hardware, household supplies	234.8	217.5	204.4	183.1	166.6
Candy, biscuits, crackers	359.7	357.3	314.8	230.7	155.1
Perishable bakery	286.7	270.8	236.9	186.7	140.3
Cosmetics and medicine	319.3	354.1	380.7	380.1	236.0
Paper goods (including book mailers)	337.8	312.3	293.3	191.9	127.2
Retail food carryout (boxes and trays)	255.8	250.9	225.8	114.8	77.0
All other uses	147.7	153.1	141.9	108.6	99.6
Miscellaneous	132.2	130.5	93.6	67.2	68.1
Total	**$4,637.0**	**$4,354.0**	**$3,940.0**	**$3,129.0**	**$2,227.0**

manufacture of rigid setup boxes, according to API. Approximately 500 facilities manufactured setup boxes in the early 1960s, but the number dwindled to about 175 firms by 1986. Accordingly, employment fell by almost half, from approximately 20,500 in 1962 to 10,600 in 1982. The low point was reached in 1984, when just 9,300 people were working. The industry rebounded to about 9,700 in 1986. Since the early 1980s, the industry has largely halted its downward spiral. Subsequent fluctuations in growth are attributable to U.S. economic trends and to changing disposable income and consumer spending levels.

The traditional rigid box is more expensive to produce than a folding carton, so rigid boxes are primarily used to package products sold at high profit margins, such as stationery, jewelry, toiletries, and chocolates. In recent years, the industry has improved its competitive position by restructuring through mergers and acquisitions. It has also improved its cost-effectiveness and productivity, diversified its product mix, and entered new markets. Some producers have added folding carton plants and paperboard/plastic combinations and laminations to their product lines. In addition, new technology has enabled the industry to expand into packaging for computer software, video equipment, food and beverages, advertising specialties, cosmetics and soaps, confectionery, and products previously dominated by other packaging mediums.

SHIPPING SACK END-USE MARKETS

(million sacks)

End use	1989	1988	1987	1984
Seeds	170	176	149	189
Sugar	64	65	63	63
Dog and cat food	282	274	244	211
Flour and flour mix	167	163	154	140
Livestock and poultry feed	387	409	407	446
Other agriculture and food	354	367	353	335
Subtotal	**1,424**	**1,454**	**1,370**	**1,384**
Cement and mortar mix	235	239	222	169
Portland cement	82	87	96	101
Masonry cement	66	68	70	84
Insulation	22	21	23	52
Other building materials	143	154	152	149
Subtotal	**548**	**569**	**563**	**555**
Fertilizer	127	159	143	170
Plastic materials	118	128	123	132
Salt and water softeners	114	118	116	126
Other chemicals	291	323	294	333
Subtotal	650	728	676	761
Clays	123	132	118	151
Limestone	109	110	104	124
Other minerals	141	158	148	181
Subtotal	**373**	**400**	**370**	**456**
Miscellaneous	335	359	305	233
Total	**3,332**	**3,509**	**3,284**	**3,389**

Source: Paper Shipping Sack Manufacturers' Assn.

U.S. PRODUCTION OF UNBLEACHED KRAFT AND RECYCLED PAPERBOARD FOR TUBE, CAN, AND DRUM STOCKS

(000 short tons)[1]

Year	Kraft	Recycled
1989	60	1,146
1988	68	1,151
1987	65	1,124
1986	54	1,043
1985	64	1,021
1984	74	1,038
1983	99	858
1982	151	767
1981	334	808
1980	220	564
1979	232	628
1978	202	602
1977	180	680
1976	172	702
1975	145	631
1974	213	733
1973	215	763
1972	216	728
1971	159	642
1970	194	573
1969	180	527

1. Some bleached kraft paperboard is also produced for these uses, but is not included in these data.
Source: Bureau of the Census.

END USES FOR RIGID PAPER BOXES

(% distribution)

End use	1980	1970
Textile, apparel, hosiery	4.4%	18.9%
Department stores and specialty shops	6.8	13.1
Cosmetics and soaps	5.5	6.2
Confections	12.6	7.9
Stationery and office supplies	13.5	8.2
Jewelry and silverware	9.3	3.2
Photographic	4.5	2.6
Shoe and leather	0.3	4.4
Drugs, chemical, pharmaceuticals	7.5	4.2
Toys and games	1.4	7.0
Hardware and household supplies	5.5	4.9
Food, beverages	4.3	0.8
Sporting goods	1.2	2.6
Electronics	3.6	—[1]
Educational	3.7	—[1]
Other and miscellaneous customers	15.9	9.6

1. Listed under other and miscellaneous customers.
Source: National Paperbox & Packaging Assn.

Outlook. Despite the resurgence of the rigid paperboard box industry in the late 1980s, annual production of setup boxboard has shown little growth because the industry's new technologies enable it to construct stronger boxes using lower-density boxboard. The industry has incorporated plastics and other materials to create laminates with greater strength and moisture resistance, among other product improvements. This trend will continue.

Rigid box shipments are expected to edge up about 1.5% annually during 1990-94, provided that the industry continues to adapt its packaging products to new, high-value consumer goods. In some of their traditional markets, setup boxes will be challenged by folding cartons and plastics, but they are expected to retain market share in high-value specialty packaging. Growth markets are expected to include packaging for cosmetics, pharmaceuticals, confectionery, and electronics.

FIBER CANS, DRUMS, AND TUBES

Composite cans, tubes, and cores are produced by the spiral or convoluted winding of paperboard strips around a core or mandel. The paperboard can be recycled board, kraft paperboard, or semichemical board. Strength is produced by the use of two or more plies. If special barriers are required, the board is first laminated with plastics or foil or else coated with hotmelts and other specialty coatings. An adhesive, such as dextrine, is applied to the strips during winding. The endless formed tube is cut on a mandel to desired sizes. For composite cans, either metal or plastic caps are used to seal the ends.

The market matured in the 1980s, mainly because composite cans have not been able to penetrate new, high-volume, consumer packaging areas. Furthermore, composite cans have lost most of their market share for motor oil and frozen-juice-concentrate packaging. The composite fiber can sector now accounts for only about 30% of the industry's total value of shipments, down from 47% in 1982. On the positive side, however, demand for fiber tubes and cores from the manufacturing sector has remained stable. The industry's tube and core sector grew an estimated 2% in 1990. However, sales of industrial fiber drums declined by about 15% in 1990.

In 1990, an estimated 1.3 million tons of recycled paperboard and 130,000 tons of unbleached kraft paperboard were used in the manufacture of tubes, cores, cans, and drums. The total value of shipments of this industry is estimated to have grown almost 2% in 1989, but sales fell in 1990 to below $1.7 billion. Sales are expected to remain depressed in 1991-92 due to the expected slower pace of industrial activity.

Sonoco Products Co., Jefferson Smurfit, Caraustar Industries Inc., and Greif Brothers Corp. dominate the industrial sector of this business, with Sonoco and Jefferson Smurfit also being major players in the consumer products sector. All but Greif Brothers are integrated producers who manufacture nearly 100% of their own paper supply. Sonoco, Greif, and Jefferson Smurfit's affiliate Container Corp. of America also produce plastic industrial drums, which allows these producers to offer a wide range of products.

Shipments of tubes and cores have shown modest growth in recent years. The largest markets for tubes are consumer and industrial packaging and shipping. Composite tubes and cores account for about 40% of the industry's shipments. The largest single market for cores is the paper industry, where they are widely used for paper mill roll cores, inner cores for towel and tissue products, and office supplies. The markets for solid-fiber drums cut across industrial, chemical, and construction sectors. Fiber drums have shown surprising growth in recent years due to growth in the hazardous-waste industry.

FIBER CANS, DRUMS, AND SIMILAR PRODUCTS: SHIPMENTS AND TONNAGE BY TYPE (SIC CODE 2655)

	1987	1982	1977	1972
Fiber drums				
Product shipments (million $)	311.5	289.8	223.8	136.9
Product shipments (000 tons)	n.a.	137.4	149.4	160.1
Fiber and composite cans				
Product shipments (million $)	448.2	701.4	469.0	253.2
Product shipments (000 tons)	n.a.	212.5	210.9	216.1
Cores and tubes				
Product shipments (million $)	532.7	341.7	263.4	164.3
Product shipments (000 tons)	817.8	748.3	638.7	624.5
Paperboard cores, reels[1]				
Product shipments (million $)	48.7	48.8	36.7	31.0
Product shipments (000 tons)	29.0	41.0	63.5	79.1
Vulcanized fiber products[2]				
Product shipments (million $)	40.5	25.4	6.6	14.0
Product shipments (000 tons)	n.a.	n.a.	n.a.	34.3
Other, not specified				
Product shipments (million $)	n.a.	35.0	40.8	20.0

n.a. = Not available.
1. Includes spools, bobbins, and blocks.
2. Includes boxes, cans, tubes, drums.
Source: Bureau of the Census.

MOLDED PULP PRODUCTS

Pressed and molded pulp goods are made in a unique wet-forming process from virgin or recycled pulp. Products include egg cartons, plates, dishes, prepackaging trays, meat boards and other food trays, fiber pipes, conduit, and fittings. After a steady decline in sales due to the growth of various plastic and polystyrene products between 1973 and 1983, the molded pulp industry has regained market position, owing largely to the growing preference for environmentally "correct" products. In 1989, the last year for which data is available, sales of pressed and molded pulp products were valued at $338 million, marking the sixth consecutive year of growth.

Despite this market turnaround, the number of molded pulp producers continues to decline in the face of plastic and polystyrene competition. Most industry capacity is held by four producers. The number of North American molded and processed pulp manufacturing sites, including those in Mexico, has dropped by more than half over the past 15 years to about 22 facilities in 1989.

The largest molded pulp producer, Cascades Inc., continued to grow in 1989. In May, the company acquired all the assets of Diamond Fiber Products Inc., Palmer, Mass., for an undisclosed amount. The Diamond Fiber Products plant, which now operates under the name Cascades Diamond Inc., makes molded paper products, mainly egg cartons. In the future, the company plans to "substantially increase" the plant's output.

Packaging Corp. of America plans on investing $7 million for new machinery and equipment upgrades to increase the capacity of its molded fiber plant in Macon, Ga. The expansion will increase the plant's egg carton production capacity by more than 40%. The upgrade is prompted by increased demand for recycled packaging. The plant uses about 30,000 tpy of recovered wastepaper.

Keyes Fibre Co., Stamford, Conn., along with PCA, is a major producer of molded food-service disposables sold under the Chinet trade name. On the plastics side, Dolco Packaging Corp., Sherman Oaks, Calif., and Fripp Fibre Forms Inc., Winnipeg, Man., are the two largest producers of polystyrene foam egg cartons.

Manufacturing process. Molded pulp products are made directly from woodpulp or repulped wastepaper. The woodpulp furnish is short-fibered, derived usually from clean grades of wastepaper, although groundwood and hardwood sulfate pulps are also used. The secondary fiber or market pulp is first made into a slurry in a conventional pulper and then refined, sized, and formed.

Fibers are drawn from a liquid slurry onto preformed molds by either vacuum suction or cloth covers that catch the fibers. The maximum possible amount of water—usually 25% to 30%—is first removed mechanically, and then the molded pulp is either passed through heated tunnels or pressed between heated dies. Molding, pressing, and drying are done in a continuous process.

Emery International Developments, Markham, Ont., is the leading supplier of manufacturing equipment for molded pulp packaging.

Market trends. Molded pulp products are classified into five categories: consumer, food service, retail food packaging, food distribution, and specialty products. These items should not be confused with solid bleached paperboard products, called pressed board, which are machine-stamped or pressed into forms such as dishes or trays for microwave packaging (see Bleached Paperboard chapter).

The consumer sector is the primary market for molded pulp products. Retail food packaging (particularly egg cartons) and food distribution (especially egg trays and fruit packaging trays) are also major markets.

Consumer products such as disposable tableware (cups, plates, and bowls) are sold in retail stores directly to the consumer. Pressed paperboard reportedly dominates this market, and molded pulp products have the second largest

TYPICAL MOLDED PULP PRODUCTS BY END USE

Consumer products
- Tableware
- Plates
- Dishes

Food service
- Plates
- Trays (bottle, food, etc.)
- Carry-out containers

Food distributors
- Egg cases
- Egg trays
- Fruit packs

Food packaging
- Egg cartons
- Meat trays
- Poultry trays
- Cake circles

Specialty
- Florist vases
- Flower pots
- Seed pots
- Interior packaging
- Minnow buckets

STATISTICS OF U.S. PRESSED AND MOLDED PULP INDUSTRY

Year	Number of establishments	Employees (000)	Value of shipments (million $)
1990e	22	2.9	$260
1989e	22	3.0	260
1988e	22	3.0	250
1987	23	3.1	240
1986	—	3.0	270
1985	—	2.9	260
1984	—	3.0	235
1983	—	3.2	227
1982	32	3.2	222
1981	38	3.2	239
1980	—	4.4	225
1979	—	4.6	220
1978	—	5.0	226
1977	38	4.9	240
1976	—	5.3	218
1975	—	5.3	210
1974	—	5.6	205
1973	—	5.6	168
1972	49	6.1	163
1967	58	6.7	146

e = Estimate.
Source: U.S. Dept. of Commerce.

share. But plastic is "making obvious inroads," according to one industry observer.

Beginning in the early 1970s, plastics and polystyrene eroded a significant portion of molded pulp's share of the food packaging market, especially egg cartons. Although polystyrene cartons maintain a slightly higher market share, in recent years, consumer preference has been gradually shifting back toward molded pulp egg cartons because of their high strength, crush resistance due to thick cushioning, and biodegradability.

International trade in molded pulp products is small because of the high bulk-to-value rate of these products. In 1988, exports were valued at $5.5 million, a 5.8% increase from the 1987 level. Major U.S. export markets for pressed and molded pulp goods in 1988 were Canada (34% of total export value), Hong Kong (16%), the U.K. (11%), and Costa Rica (8.5%). In 1988, U.S. imports of all pressed/molded pulp goods decreased 10% in value, from $23.0 million to $20.7 million. Primary suppliers to the U.S. market in 1988 were Canada (62% of total import value), the Philippines (9.5%), and Fed. Rep. Germany (6.5%).

Outlook. Growth in the molded pulp sector will depend upon its ability to establish its products as biodegradable, economical, and adaptable for a wide range of packaging needs. The pressed and molded pulp goods industry is expected to continue expanding, with a 2.3% increase in product shipments during 1990-94, according to DOC analyst Gary Stanley. This growth should occur primarily in the food-packaging sector, despite increased competition from plastic, polystyrene, and other nonpulp-based packaging materials. International trade within this sector will remain relatively small, as exports increase by 5.5% and imports by almost 3%.

Competition from plastics and polystyrene products—especially egg cartons—will increase during the next five years. New packaging media using crystallized polyethylene and polystyrene resins will increase competitive pressure on packages made from traditional materials. But molded pulp products are expected to gain market share as consumers become more aware of the nonbiodegradability of plastic products.

Growth in the molded pulp industry will depend on establishing new end uses for its products, such as trays for use in microwave and conventional ovens (currently, over 70% of U.S. households have at least one microwave oven). The industry can also stress the benefits its products offer in biodegradability and in economical, durable protection for a wide variety of packaging needs.

NORTH AMERICAN PRESSED AND MOLDED PULP PRODUCERS

Company	Location	Capacity (tpd)
American Fibrit Inc.	Battle Creek, Mich.	30
Cascades Inc.	Kingsey Falls, Que.	25
	Rockingham, N.C.	9
Cascades Diamond Inc.	Palmer (Thorndike), Mass.	75
Cascade Dominion Packaging Ltd.	Brantford, Ont.	40
CKF Inc.	Hantsport, N.S.	n.a.
Fibre Form Corp.	Columbia City, Ind.	n.a.
Fripp's Fibre Form Ltd.	Tisdale, Sask.	15
Henry Molded Pulp Products Inc.	Lebanon, Pa.	24
Keiding Inc.	Milwaukee, Wis.	n.a.
Keyes Fibre Co.	Albertville, Ala.	n.a.
	Hammond, Ind.	n.a.
	Sacramento, Calif.	n.a.
	Waterville, Maine	n.a.
	Wenatchee, Wash.	n.a.
Middleton Packaging Inc.	City of Industry, Calif.	15
Montrose Paper Inc.	Chicago, Ill.	82
Packaging Corp. of America	Griffith, Ind.	88
	Macon, Ga.	100
	Plattsburgh, N.Y.	40
	Red Bluff, Calif.	n.a.
Tekmold Inc.	Muskegon, Mich.	8
Woodstream Corp.	Lititz, Pa.	n.a.

n.a. = Not available.

ENVELOPES

The envelope industry manufactures a wide variety of packaging products used by both consumers and businesses. The industry had sales of about $3.2 billion in 1990, based on output of nearly 200 billion envelopes in the U.S. and Canada. These estimates are based on data collected by the Envelope Manufacturers Assn. of America & Canada and DOC. The volume of sales has increased during the last

U.S. ENVELOPE PAPER SHIPMENTS

(000 short tons)

Year	Total	White wove	Kraft[1]
1990	1,228	979	249
1989	1,140	906	234
1988	1,211	942	269
1987	1,172	916	256
1986	1,121	867	254
1885	1,024	789	235
1984	1,011	774	237
1983	946	715	231
1982	847	639	208
1981	860	638	222
1980	876	650	226
1979	869	635	234
1978	822	592	230
1977	757	554	203
1976	724	520	204
1975	621	457	164

1. Includes bleached, semibleached, and unbleached kraft papers.
Source: American Paper Institute.

seven years, despite increased use of electronic mail and message systems, facsimile machines, and other electronic systems.

Envelopes are manufactured in three basic types: 1) white, kraft, and colored personal and business stationery envelopes; 2) heavy-duty, padded shipping envelopes and mailers; and 3) clasp and string-and-button envelopes. These envelopes are made from a variety of materials, including paper, plastic, nylon, and paper/plastic laminations.

Paper envelopes are made from three major grades of uncoated paper: white wove, unbleached kraft, and bleached kraft. High-quality business envelopes are made mostly from white-wove grades and bleached or semi-bleached kraft grades. Business, heavy-duty, and padded shipping envelopes are made from unbleached kraft grades or recycled papers. A small amount of envelopes is made with coated papers. The envelope industry used about 1.2 million tons of various paper grades in 1990, a slight increase from the year before.

In 1990, 71% of the industry's shipments were business and commercial stationery envelopes, which were valued at $2.17 billion. The leading use for these envelopes is in direct-mail advertising. These direct-mail envelopes are the fastest-growing segment of the envelope industry. Sales of heavy-duty and padded shipping envelopes were valued at $520 million in 1990 and accounted for 17% of all U.S. envelope sales. Clasp and string-and-button envelope sales in 1990 were $308 million and accounted for 10% of sales.

Industry trends. In 1991, International Paper put its envelope business up for sale, signaling an exit by one of the largest U.S. envelope converters. IP's envelope group had 1990 sales of $170 million and included eight converting plants in the U.S. Westvaco claims to be the largest U.S. envelope manufacturer, with nine production plants in the U.S. that use an estimated 100,000 tons of paper annually. Westvaco does not disclose financial details, but industry analysts estimate the envelope division contributes about 10% of company sales, or $240 million in 1990. Georgia-Pacific's Mail-Well Envelope unit has 17 manufacturing locations in the U.S. and produces 15 billion envelopes annually.

Other major independent envelope manufacturers include American Envelope Co. and New York Envelope Co. Also, Sealed Air Corp. of Saddle Brook, N.J., is the leading producer of padded shipping envelopes, which are marketed under the Jiffy trade name. Ivex Corp. of Houston, Texas, also manufactures padded shipping envelopes under the Jet-Pak trade name.

Outlook. DOC estimates that envelope shipments will increase about 2.5%/year during 1990-94. Product shipments of all types of envelopes are forecast to parallel the growth of GNP and slightly exceed gains in general U.S. business activity and consumer disposable income.

However, industry executives estimate that envelope shipments declined about 4% in 1990. Most of the weakness was in direct-mail advertising, which was affected by higher postal rates. U.S. postal receipts for third-class mail showed a downward trend through mid-1991, dropping about 6%. Third-class mail volume has traditionally declined or leveled off immediately after a postal rate hike before returning to a positive growth pattern. The expected upturn may be delayed, however, because of the continuing weak U.S. economy and advertising market.

Generally, growth in white-wove envelope shipments should exceed real GNP growth, while shipments of unbleached kraft will be close to GNP levels. Reduced levels of advertising will have a dampening effect on envelope shipments in 1991, but growth should resume thereafter.

The future impact of electronic mail systems and electronic fund transfers is difficult to predict because consumer acceptance has been slow. The impact on envelope de-

STATISTICAL SUMMARY FOR SIC CODE 2677: ENVELOPES

Year	Plants	Employees	Value of shipments ($ million)	Capital expenditures ($ million)
1990e	—	28,400	$3,200	—
1989e	—	28,300	3,150	—
1988e	—	28,300	2,936	$72.1
1987	298	27,600	2,598	61.8
1986	—	25,200	2,230	72.8
1985	—	24,000	2,086	74.1
1984	—	25,100	2,169	63.5
1983	—	24,800	1,888	32.6
1982	296	24,400	1,771	45.1
1981	—	25,600	1,601	38.1
1980	—	25,600	1,460	55.2
1979	—	24,900	1,304	38.7
1978	—	22,900	1,121	29.3
1977	265	22,600	991	22.9
1976	—	21,700	870	22.7
1975	—	21,900	830	19.1
1974	—	24,300	868	19.2
1973	—	23,300	690	21.1
1972	247	22,900	621	17.4
1971	—	22,400	573	23.1
1970	—	23,400	574	21.6

Paper consumed (estimated)[1]:
1987: n.a.
1982: 822,800 short tons
1977: 677,000 short tons
1972: 695,000 short tons
Number envelopes produced:
1987: n.a.
1982: n.a.
1977: 97,889 million
1972: 96,599 million

Note: Some SIC codes for converted products have been renumbered according to the 1987 Standard Industrial Classification Manual. Although the SIC numbers are different, the categories they describe are the same as the 1982 census, except where otherwise noted.
e = Estimate.
n.a. = Not available.

[1] An estimated 13,000 tons of paperboard included for 1977 and 29,000 for 1972.

Source: Bureau of the Census.

mand could be serious, however, if large-volume envelope users, such as banks, credit card firms, and retail stores, adopt the new technology. A more immediate impact has come from the growing use of overnight and express mail services. These firms use heavyweight mailers made from plastics or coated paperboard, rather than conventional envelope paper grades. The growth of these services has affected envelope demand in recent years and will continue to penetrate the traditional market for envelopes. The continued market penetration of plastic envelopes will also be a factor.

BAGS (EXCEPT TEXTILE): SHIPMENT AND TONNAGE BY TYPE

	1987	1982	1977
Grocers bags and sacks			
Product shipments (million $)	916.4	917.1	612.6
Product shipments (000 tons)	1,657.9	1,913.1	1,699.0
Variety (merchandise) bags			
Product shipments (million $)	106.7	152.6	139.7
Product shipments (000 tons)	123.1	212.8	255.1
Shopping bags (uncoated)			
Product shipments (million $)	60.8	37.4	33.2
Product shipments (000 tons)	35.0	30.0	42.0
Other paper bags			
Product shipments (million $)	24.7	56.8	12.3
Product shipments (000 tons)	n.a.	56.1	21.9
Specialty bags and liners (coated)			
Product shipments (million $)	400.4	205.5	210.6
Product shipments (000 tons)	n.a.	153.1	n.a.
Shipping sacks (single and multiwall)			
Product shipments (million $)	1,187.3	846.5	658.8
Product shipments (000 tons)	n.a.	n.a.	997.6

Note: Polyethylene grocery and variety bag tonnage was estimated at 133,000 tons valued at $267.8 million in 1982. Plastic shipping sack: 22,000 tons valued at $38.6 million.
n.a. = Not available.
Source: Bureau of the Census.

STATISTICAL SUMMARY FOR SIC CODE 2675: DIE-CUT PAPER AND BOARD

Year	Plants	Employees	Value of shipments ($ million)	Capital expenditures ($ million)
1987	393	15,500	$1,739	$29.4
1986	—	17,900	1,795	31.0
1985	—	16,900	1,730	35.0
1984	—	17,500	1,931	46.7
1983	—	16,300	1,898	30.4
1982	398	15,900	1,680	32.7
1981	—	17,200	1,677	23.2
1980	—	16,600	1,454	41.0
1979	—	17,000	1,468	32.7
1978	—	15,100	1,189	26.4
1977	371	14,300	1,058	15.3
1976	—	15,300	1,027	28.6
1975	—	14,800	943	17.1
1974	—	16,500	923	23.3
1973	—	15,900	747	12.9
1972	374	15,200	676	10.6
1971	—	17,300	612	17.8
1970	—	18,200	612	17.8

Paper consumed (estimated):
1987: n.a.
1982: 355,400 short tons
1977: 259,000 short tons
1972: 510,000 short tons

Paperboard consumed (estimated):
1987: 641,100 short tons
1982: 983,600 short tons
1977: 927,000 short tons
1972: 953,000 short tons

Note: Some SIC codes for converted products have been renumbered according to the 1987 Standard Industrial Classification Manual. Although the SIC numbers are different, the categories they describe are the same as the 1982 census, except where otherwise noted.
n.a. = Not available.
Source: Bureau of the Census.

STATISTICAL SUMMARY FOR SIC CODE 2676: SANITARY PAPER PRODUCTS

Year	Plants	Employees	Value of shipments ($ million)	Capital expenditures ($ million)
1987	129	38,100	$11,593	$429
1986e	—	37,800	11,153	466
1985	—	38,000	10,751	487
1984	—	38,100	10,327	313.0
1983	—	36,700	9,240	373.0
1982	138	36,700	9,086	271.1
1981	—	36,600	8,346	248.2
1980	—	37,700	7,636	250.9
1979	—	37,700	6,615	265.4
1978	—	35,000	5,591	210.6
1977	120	34,500	4,921	199.1
1976	—	32,900	4,410	108.4
1975	—	31,400	3,884	121.2
1974	—	31,300	3,265	65.2
1973	—	28,200	2,325	109.0
1972	108	26,300	2,072	119.6
1971	—	24,000	1,716	52.9
1970	—	24,600	1,654	50.5

Paper consumed (estimated):
1987: 3,488,600 short tons
1982: 3,598,100 short tons
1977: 3,651,000 short tons

Note: Some SIC codes for converted products have been renumbered according to the 1987 Standard Industrial Classification Manual. Although the SIC numbers are different, the categories they describe are the same as the 1982 census, except where otherwise noted.
e = Estimate.
Source: Bureau of the Census.

STATISTICAL SUMMARY FOR SIC CODE 2678: STATIONERY PRODUCTS

Year	Plants	Employees	Value of shipments ($ million)	Capital expenditures ($ million)
1987	189	11,500	$1,229	$25.4
1986	—	12,700	1,201	43.5
1985	—	12,400	1,102	48.9
1984	—	13,600	1,173	42.2
1983	—	13,100	1,132	20.8
1982	214	12,600	1,034	21.4
1981	—	11,900	892	13.1
1980	—	13,000	836	12.7
1979	—	13,400	766	14.6
1978	—	13,900	747	18.4
1977	242	12,600	652	15.9
1976	—	12,300	653	12.7
1975	—	12,100	591	15.5
1974	—	13,300	605	8.0
1973	—	15,000	493	6.5
1972	431	14,700	450	9.3

Paper consumed (estimated):
1987: 536,800 short tons
1982: 447,300 short tons
1977: 470,000 short tons
1972: 511,000 short tons

Note: Some SIC codes for converted products have been renumbered according to the 1987 Standard Industrial Classification Manual. Although the SIC numbers are different, the categories they describe are the same as the 1982 census, except where otherwise noted.
Source: Bureau of the Census.

STATISTICAL SUMMARY FOR SIC CODE 2679*: MISCELLANEOUS CONVERTED PRODUCTS

Year	Plants	Employees	Value of shipments ($ million)	Capital expenditures ($ million)
1987	785	30,700	$3,672	$75.6
1986	—	28,400	3,223	73.0
1985	—	29,300	3,136	70.4
1984	—	31,600	3,196	70.1
1983	—	31,700	2,817	36.2
1982	809	30,400	2,638	74.3
1981	—	33,300	2,836	57.9
1980	—	35,200	2,554	76.5
1979	—	34,700	2,263	92.9
1978	—	35,100	2,126	92.8
1977	871	34,300	1,938	62.0
1976	—	28,100	1,507	35.2
1975	—	27,000	1,301	37.0
1974	—	29,600	1,284	49.8
1973	—	27,600	1,001	33.4
1972	356	24,200	793	25.5

Paper consumed (estimated):
1987: n.a.
1982: 574,300 short tons
1977: 424,000 short tons
1972: 495,000 short tons
Paperboard consumed (estimated):
1987: 224,000 short tons
1982: n.a.
1977: 169,000 short tons
1972: 112,000 short tons

Note: Some SIC codes for converted products have been renumbered according to the 1987 Standard Industrial Classification Manual. Although the SIC numbers are different, the categories they describe are the same as the 1982 census, except where otherwise noted.
* = Industry definition changed for 1987.
n.a. = Not available.
Source: Bureau of the Census.

STATISTICAL SUMMARY FOR SIC CODE 2657*: FOLDING PAPERBOARD BOXES

Year	Plants	Employees	Value of shipments ($ million)	Capital expenditures ($ million)
1987	601	50,500	$5,687	$180.3
1986e	—	36,200	4,560	—
1985	—	36,000	4,447	—
1984	—	35,600	4,421	131.0
1983	—	42,600	3,967	94.3
1982	564	43,700	3,902	105.0
1981	—	44,300	3,557	101.0
1980	—	45,500	3,277	92.2
1979	—	45,000	2,950	76.8
1978	—	45,600	2,884	100.0
1977	574	44,700	2,579	89.8
1976	—	40,600	2,233	65.2
1975	—	38,300	1,952	67.0
1974	—	43,200	1,890	60.0
1973	—	45,300	1,644	41.8
1972	544	45,300	1,487	37.4
1971	—	44,900	1,366	33.7
1970	—	48,700	1,387	49.9

Paperboard consumed:
1987: 3,977,800 short tons
1982: n.a.

Note: Some SIC codes for converted products have been renumbered according to the 1987 Standard Industrial Classification Manual. Although the SIC numbers are different, the categories they describe are the same as the 1982 census, except where otherwise noted.
* = Industry definition changed for 1987.
n.a. = Not available.
e = Estimate.
Source: Bureau of the Census.

STATISTICAL SUMMARY FOR SIC CODE 2655: FIBER CANS, DRUMS, AND SIMILAR PRODUCTS

Year	Plants	Employees	Value of shipments (million $)	Capital expenditures (million $)
1987	280	12,400	$1,517	$70.9
1986	—	12,600	1,517	63.1
1985	—	13,500	1,697	60.5
1984	—	13,900	1,692	41.1
1983	—	14,100	1,627	35.0
1982	307	14,100	1,474	31.1
1981	—	16,200	1,496	37.3
1980	—	15,900	1,370	42.9
1979	—	17,100	1,297	31.2
1978	—	16,300	1,119	23.6
1977	309	16,100	1,011	26.7
1976	—	16,600	936	26.6
1975	—	16,900	837	27.5
1974	—	19,600	828	30.5
1973	—	18,200	673	16.8
1972	282	17,300	568	17.9
1971	—	16,200	495	16.4
1970	—	16,500	465	16.1
1969	—	16,400	445	16.8

Note: Some SIC codes for converted products have been renumbered according to the 1987 Standard Industrial Classification Manual. Although the SIC numbers are different, the categories they describe are the same as the 1982 census, except where otherwise noted.
Source: Bureau of the Census.

STATISTICAL SUMMARY FOR SIC CODE 2652: SETUP PAPERBOARD BOXES

Year	Plants	Employees	Value of shipments (million $)	Capital expenditures (million $)
1987	—	8,600	$433.5	$10.3
1986	—	9,100	552	13.2
1985	—	9,200	479	16.8
1984	—	9,300	466	18.0
1983	—	12,300	569	14.1
1982	261	10,600	433	10.0
1981	—	13,700	511	18.6
1980	—	13,500	465	16.2
1979	—	13,400	434	14.6
1978	—	13,700	409	17.6
1977	312	13,100	361	8.8
1976	—	15,500	402	4.6
1975	—	14,500	350	15.1
1974	—	18,300	387	5.6
1973	—	16,000	320	5.7
1972	395	18,100	321	6.4
1971	—	19,700	332	8.5
1970	—	22,000	326	12.0

Paperboard consumed (estimated):
1987: n.a.
1982: 199,800 short tons
1977: n.a.

Note: Some SIC codes for converted products have been renumbered according to the 1987 Standard Industrial Classification Manual. Although the SIC numbers are different, the categories they describe are the same as the 1982 census, except where otherwise noted.
n.a. = Not available.
Source: Bureau of the Census.

PLASTIC RESINS AND CONVERTED PRODUCTS

Plastic resins and films are used in a variety of paper converting operations and represent the principal competition to paper and paperboard packaging. Polyethylene (PE), the largest-volume plastic resin in packaging, is used to make retail bags, garbage bags, milk jugs, soft-drink bottles, food packaging, and a variety of other items. PE and latex resins are also used by the paper industry for coating, binding, and laminating applications. In addition, most paper tissue and towel products are wrapped and bundled in plastic film. Other major resins used in packaging include polystyrene (PS), polypropylene (PP), polyethylene terephthalate, and, to a lesser degree, polyvinyl chloride (PVC).

The U.S. plastics industry was dramatically affected by the Gulf War in 1990-91. In 1990, total industry production increased 5.8% to 61.9 billion lb as processors purchased record amounts of resin to avoid any possible supply disruption during the Gulf War crisis. Prices skyrocketed to record levels as a result of hedge buying that continued into early 1991.

Annual growth for plastics over the past 25 years has averaged above 5%/year. Plastics have replaced other materials in hundreds of applications, including food containers, carpet fibers, furniture, and automobile parts. Paper and paperboard products facing competition from plastics include kraft bags/sacks, milk cartons, folding cartons, paper cups/plates, composite cans, and corrugated containers. Packaging consumed an estimated 14.8 billion lb of plastic resins in 1990, or about 25% of total industry sales.

Prices of commodity plastic resins rose dramatically during the Gulf War crisis but then fell sharply by mid-1991. Film-grade, low-density PE (LDPE) prices fell to 27¢ to 29¢/lb by mid-1991, down from as much as 48¢/lb in early 1991. High-density PE (HDPE), bottle-grade prices fell to 38¢ to 39¢/lb from a peak of 46¢ to 47¢/lb.

Volatile market cycles are endemic to the plastics industry. In early 1989, producer prices began eroding as substantial amounts of new capacity started coming online. Benchmark PE grades that sold for more than 50¢/lb in the spring dropped to 35¢ to 40¢/

U.S. PRODUCTION OF SELECTED RESINS

(million lb)

Year	LDPE[1]	HDPE[1]	PS	PP	PVC	Total industry[2]
1990	11,148	8,337	5,021	8,310	9,096	61,960
1989	9,695	8,102	5,104	7,238	8,478	58,529
1988	10,397	8,400	5,187	7,274	8,350	59,762
1987	9,599	7,995	4,780	6,647	7,971	55,751
1986	8,903	7,182	4,470	5,812	7,256	50,848
1985	8,889	6,671	4,054	5,139	6,772	47,946
1984	8,413	6,085	3,838	4,940	6,760	46,336
1983	8,041	5,691	3,767	4,434	6,066	42,777
1982	7,503	4,928	3,191	3,477	5,326	36,607
1981	7,693	4,695	3,621	3,955	5,707	39,867
1980	7,291	4,405	3,521	3,648	5,470	37,347
1979	7,793	5,010	4,005	3,841	6,119	41,577

1. Includes LLDPE/HDPE swing capacity.
2. Total includes some resins not listed.
Source: Society of the Plastics Industry.

lb in the third quarter. The market was further disrupted by a sharp drop in exports to People's Rep. China. Efforts to hold prices firm were undermined by excess resin supply.

During the first half of the 1970s, the plastics industry initiated a similar series of expansion and debottlenecking projects as resin inventories became increasingly tight. Eventually, the expansions led to significant overcapacity, resulting in a downward trend in profits and lower prices for resins. These market conditions prompted several major petrochemical companies to sell their commodity plastic resin businesses. However, current activity suggests that resin producers are formulating their strategies more prudently, especially with respect to the four major packaging resins: LDPE, HDPE, PP, and PS. Despite periodic disruptions, most producers believe that over the long haul—across both the peaks and troughs of the business cycle—the plastic market will continue to expand.

With few exceptions, most major U.S. resin producers are diversifying their revenue base away from the cyclical commodity resin business and integrating production of downstream consumer products. Leading producers such as Amoco Chemical, Dow Chemical, Exxon, Mobil Chemical, and Union Carbide have all made investments in recent years to expand downstream fabrication of value-added products and to increase their total market share. For example, Dow Chemical, which produces PE resins and film, moved into consumer goods with the development of Ziploc resealable plastic bags, a product worth an estimated $250 million in annual sales. Dow increased the value of its PE film by a factor of four when it was converted downstream into bags.

The short-term outlook for major-volume resins is not good. The recent expansion of capacity and the current economic slowdown are leading the industry toward substantially lower profits. Capacity expansions announced by U.S. producers for 1990 or 1991 startup amount to an increase of 22% for PE, 16% for PP, 6% for PS, and 16% for PVC. Some capacity has been lost to plant explosions in each of the past two years, so actual growth rates may be lower. Still, assuming that all of this planned capacity is brought online, utilization rates by early 1992 could be only 81% for PE, 69% for PP, 80% for PS, and 77% for PVC.

Although every major plastic resin will show some growth over the next several years, the pace will slow. In packaging, plastic's market penetration is being spurred along by the development of new plastic materials that provide equal or better performance at a lower cost per unit than other materials. However, these technological achievements are being overshadowed by environmental issues. In 1990, McDonald's Corp. banned all PS-foam packaging from its worldwide chain of 12,000 restaurants. Other firms have followed suit.

Plastic's permanence in the environment (nonbiodegradability) and the low level of plastics recycling are major concerns for the future. Although plastic accounts for only 8% of municipal solid waste, it is the primary target of restrictive legislation because it is the fastest-growing segment of the packaging industry. While disposable PS-foam food containers and plastic bags have received the most negative publicity, several state and municipal governments are considering legislation to ban or tax any nonbiodegradable or nonrecyclable plastic packaging.

PLASTIC RESINS

Packaging comprised the largest category of resin sales in 1990, but growth rates slowed in 1991. Sales of the major packaging resins increased 8.5% to 34.1 billion lb in 1990, but in first-half 1991, sales increased only 2.2%. Canadian imports are included in U.S. industry sales figures published by the Society of the Plastics Industry.

Among the major packaging resins, sales of HDPE, commonly used for plastic bags and sacks and blow-molded containers, increased 8.1% in 1990 to 8.8 billion lb. Sales of LDPE, used for plastic coatings, films, and bags, increased 10.7% to 11.9 billion lb. PS sales, hurt by a sharp decline in disposable food-service packaging, dropped 1.6% to 5.0 billion lb. PP used in injection-molded food containers and flexible packaging increased 12.8% to about 8.2 billion lb.

Polyethylene. Good market conditions have prevailed in recent years for this major resin group, which accounts for one-third of total plastic industry capacity, but new capacity additions are expected to outstrip demand growth. Nine of the ten top U.S. resin suppliers announced PE capacity expansions, with 3.2 billion lb of new capacity due onstream in early 1991.

Current PE capacity is about 23.9 billion lb. Of that amount, 8.0 billion lb is HDPE, 7.9 billion lb is LDPE, and 8.0 billion lb is low-pressure capacity that can swing between linear LDPE (LLDPE) and HDPE.

HDPE demand is forecast to increase about 5% in 1991 because of strong demand for milk, juice, and bottled water containers and thin-gauge bags and sacks. The 1989 explosion at a Phillips facility in Texas shut down 20% of HDPE capacity in the U.S., but no shortages resulted because new

U.S. PRICE TRENDS FOR SELECTED RESINS

(¢/lb, fourth quarter)

Year	LDPE	HDPE	PS	PP	PVC
1990	43.0¢	43.0¢	55.0¢	42.0¢	38.0¢
1989	36.0	38.0	47.0	39.0	36.0
1988	51.0	51.0	58.0	49.0	43.0
1987	38.0	39.0	53.0	44.0	37.0
1986	28.5	32.0	35.0	34.0	29.0
1985	30.0	31.0	34.0	36.0	27.0
1984	30.0	32.3	37.0	35.0	24.0
1983	40.0	37.0	—	—	—
1982	27.0	35.5	—	—	—
1981	28.0	39.0	—	—	—
1980	34.0	37.0	—	—	—
1979	38.5	39.3	—	—	—

Sources: *Modern Plastics, Plastics News, Chemical Market Reporter.*

capacity was already coming onstream.

Conventional LDPE demand is forecast to increase about 2% in 1991, and LLDPE demand is forecast to increase over 10%. In 1990, LDPE sales increased 4.1% to 7.2 billion lb, and LLDPE sales rose 22.5% to 4.7 billion lb. Demand for thin-gauge LLDPE is strong for grocery sacks and retail bags, flexible food packaging, and shrink/stretch wrapping.

Plastics have captured 70% to 75% of the 35-billion grocery bag and sack market. Sonoco Products holds a 48% share of the total plastic grocery sack business, Mobil Chemical holds 23%, and Vanguard Plastics holds 9% to 11%. Prices of plastic bags are substantially lower than paper bag prices. For example, heavyweight kraft paper grocery sacks sell for over $40/thousand sacks, while plastic sacks sell for about $20/thousand sacks. This price differential has actually increased in the past several years, leading to further market share loss by kraft paper. Despite consumer opposition to plastics, most supermarkets remain attracted to the cost savings of plastic bags.

LDPE is also widely used as a protective barrier coating on paper and paperboard substrates. In 1990, a total of 809 million lb of LDPE resins were used for coating applications, representing about two-thirds of total consumption of plastics coatings in the U.S.

ESTIMATED CAPACITY OF TOP 20 U.S. COMPANIES PRODUCING PLASTIC RESINS

	Company	1990 annual capacity (million lb)	Major grades
1.	Quantum[1]	4,765	LDPE, LLDPE, HDPE, PP
2.	Dow	4,220	LDPE, LLDPE, HDPE, PS
3.	Oxychem[2]	3,850	LDPE, HDPE, PVC
4.	Union Carbide	3,140	LDPE, LLDPE, HDPE, PVC
5.	Exxon	2,840	LDPE, LLDPE, HDPE, PP
6.	Chevron	2,415	LDPE, HDPE, PS
7.	Mobil	2,205	LDPE, LLDPE, HDPE, PS
8.	Himont	2,200	PP
9.	Novacor[3]	2,100	LDPE, LLDPE, HDPE, PP
10.	Shintech	2,000	PVC
11.	Solvay[4]	1,970	LDPE, HDPE, PP
12.	B.F. Goodrich	1,750	PVC
13.	Amoco	1,630	PP, PS
14.	Huntsman[5]	1,610	PP, PS
15.	Fina	1,540	PP, PS
16.	Paxon Polymer[6]	1,200	HDPE
17.	Phillips[7]	1,080	HDPE, PP
18.	Eastman	1,020	LDPE, PP, PET
19.	Formosa	1,000	PVC
20.	Georgia Gulf	850	PVC

1. Formerly USI Chemicals Div. of National Distiller & Chemical Corp.
2. Formerly Cain Chemical, which was purchaed by Occidental Chemical in 1988.
3. Novacor Chemicals, a subsidiary of Nova Corp., a Canadian company, purchased Poysar in 1988.
4. Formerly Soltex Polymer Corp.
5. Huntsman purchased Shell's 325-million-lb PP plant in 1988.
6. Formerly Allied-Signal Corp.
7. A plant accident in late 1989 destroyed Phillips' 1.6-billion-lb Pasadena, Texas, HDPE facility; 600 million lb were brought back online in 1990.

Source: *Modern Plastics*.

Polystyrene. PS sales have dropped sharply since McDonald's stopped using a foam clamshell container as its primary packaging for hamburgers. Total sales of PS-foam packaging products dropped 7% to approximately 598 million lb in 1990, after many years of solid growth. Products in this segment include hinged containers, drinking cups, plates, egg cartons, and loose cushioning fill.

Although this segment represents only about 12% of the 5-billion-lb (sales) PS market, the downturn in these products signals a stormy future for PS packaging. Despite these concerns, producers are adding about 135 million lb of new capacity to the 1990 total of 6.4 billion lb.

In mid-1989, the eight major U.S. producers of PS jointly funded a $16-million program to create a Polystyrene Packaging Council. The group's goal is a 25% recycling rate for PS products by 1995 to combat environmental attacks on their products. The 25% recycling target is roughly equivalent to the paper recovery rate in 1989.

Polypropylene. After a decade of near-double-digit annual growth, PP sales in 1990 increased 12.8% to 8.2 billion lb. PP growth surpassed all other volume resins, with the exception of LLDPE resins. Industry capacity is currently about 9.2 billion lb, with plans for an additional 2.3 billion lb of new capacity after 1991.

PP resins are used to produce injection-molded food containers and bottle closures and flexible packaging films. PP resins are also used to manufacture a wide variety of medical, pharmaceutical, and electrical products. PP resins are often substituted for higher-priced resins during periods of high prices, such as in 1990.

PLASTIC PACKAGING SUPPLIERS

Food packaging is the largest segment of the plastics packaging industry, and plastic bottles and flexible films are the leading products in this segment. Plastic bottles and films are popular with food manufacturers because their barrier properties ensure freshness while preventing odors, moisture, or vapors from contaminating the product. In addition, plastic materials are lightweight, unbreakable, and often cheaper than other materials.

Constar International, headquartered in Chattanooga, Tenn., is the largest U.S. plastic container manufacturer. The company's Sewell Plastics subsidiary acquired Owens-Illinois Inc.' plastic bottle division in 1987. Other major plastic bottle producers are Johnson Controls, Continental Can, and Amoco. Leading film producers include Quantum, Dow, Union Carbide, Chevron, Phillips, Exxon, and Mobil Chemical.

Plastic bottles have made significant inroads into traditional glass and paperboard markets, and plastic films have successfully taken market share from cellophane, paper, and paperboard. Plastic bottle demand is projected to grow over 5%/year and use 7.6 billion lb of resins by 1992, according to a forecast by Freedonia Group Inc. U.S. demand for plastic film is projected to increase 3.3%/year and consume nearly 10 billion lb of resins by 1992.

Among nonfood applications, one of the most competitive markets is grocery sacks, where kraft paper has traditionally been used. High-strength PE films have captured about 70% to 75% of the market, or about 25 billion bags in 1990, up from only 5% of the market in 1983. By weight, 25 billion plastic grocery sacks equal about 550 million lb of PE.

The leading plastic grocery bag producer is Sonoco Products, which also produces paperboard cores, cans, tubes, and plastic shipping drums. Sonoco produces about 12 billion plastic bags annually and has a 48% share of the 25-billion-bag plastic market. Its chief rival is Mobil Chemical, a subsidiary of Mobil Oil, which produces about 6 billion bags annually, representing 23% of the plastic grocery sack market.

PLASTICS USE IN PACKAGING IN 1990

(million lb)

	LDPE	HDPE	PS	PP	PVC	PET	Total industry[1]
Containers	312	2,338	1,311	466	388	1,214	7,241
Closures	33	84	206	412	36	—	786
Coatings	809	53	—	35	23	11	1,186
Film	3,732	648	215	588	315	—	5,608
Total	4,886	3,123	1,732	1,501	762	1,225	14,821

1. Total includes some resins not listed.
Source: *Modern Plastics.*

PULPING AND PAPERMAKING CHEMICALS

The pulp and paper industry's use of chemicals has been reshaped considerably over the past few years, particularly by environmental forces. Chlorine's decline is accelerating, and chlorine dioxide is picking up some of the slack; at the same time, peroxygens are on the rise, and enzymes are being developed in the wings.

Chlorine has lost favor because of its role in the formation of dioxins and other chlorinated organic pollutants during pulp bleaching. However, doubts have recently arisen as to whether or not dioxins in minuscule quantities are as harmful to humans as first thought. The Environmental Protection Agency is reevaluating its stance on dioxins, and the chemical industry is sponsoring a $1.2-million "outreach program" through the Chlorine Institute to study the mechanism of dioxin formation and to find ways to keep chlorinated organics out of the waste stream. In the meantime, environmental activists are maintaining pressure on the pulp and paper industry to do away with chlorine.

Recycling is another environmental issue that is having a significant impact on the industry and its use of chemicals. By 1993, North American consumption of wastepaper will increase 45% from its 1989 level. This expanded use of secondary fiber is bringing newly developed chemical processes to the fore. For example, Air Products & Chemicals introduced its Oxypro Oʀ system process and equipment design using oxygen for bleaching and cleaning secondary fiber. The company says its system upgrades mixed waste into higher-quality finished products, such as tissue, towel, and fine paperstocks. Meanwhile, researchers at North Carolina State Univ. have developed an improved process for removing newsprint inks that is claimed to be particularly successful with colored inks. Further work with this enzyme-enhanced method could lead to high product quality levels with recycled newsprint. Researchers are also studying the use of enzymes in pulping and bleaching virgin fiber.

For now, however, the industry staples remain caustic soda, chlorine, and chlorine dioxide.

Chloralkali. Chlorine is used as a kraft pulp bleach and influent water purifier, and caustic soda is used in both kraft pulping and bleaching. Chlorine and caustic are co-products in most well-established production processes, and for years, manufacturers have relied on the balanced consumption of these two chemicals by the paper industry, one of their largest consumers.

But the movement away from chlorine has threatened that balance, with pulp and paper consumption of chlorine declining in 1991. On the other hand, exports of chlorinated derivatives, such as polyvinyl chloride, helped to buoy the sector, and chloralkali manufacturers enjoyed much higher operating rates for the year than expected. Commercial-grade caustic soda supply was tight during second-half 1990 and into the first part of 1991, but then it loosened somewhat. Rayon-grade caustic soda, used minimally in pulp mills for such activities as ion exchange generation, remains snug because some mercury-cell chloralkali plants have shut down.

Caustic soda is ranging anywhere from $250/ton for spot commercial-grade export up to $340/ton for rayon-grade U.S. consumption. The combined electrochemical unit (ECU) value of caustic soda and chlorine has declined over the last two years, primarily because chlorine prices have plummeted.

One supplier predicted the chlorine supply would tighten going into 1992 and prices would rise; also, commercial caustic soda prices would drop as supplies loosened, and rayon caustic soda prices would either stabilize or go up. The overall impact should be a fairly stable ECU value.

On a worldwide basis, annual consumption of caustic soda by all industries is expected to grow by 1.5%, while the demand for chlorine will grow by 0.85%, according to *Chemical Marketing Reporter*. This would result in a caustic soda deficit of 1.4 millions tpy in 1994 if nothing is done to eliminate the shortage. Some expansions are already in the works. For example, FMC, Tenneco, and Texas Gulf are setting up causticizing units for the conversion of Wyoming trona to caustic soda.

In a report on the U.S. pulp and paper industry's chemical use, the American Paper Institute predicted the estimated 1.30-million-tpy consumption of elemental chlorine in 1990 will drop to 0.91 million tpy by 1994. And despite a slight increase in 1991, the industry's overall annual consumption of caustic soda will decrease from its 1990 rate of 2.28 million tpy to 2.23 million tpy in 1994.

Soda ash. Soda ash is working both sides of the street, as a direct replacement for caustic soda and as a base material for the manufacture of caustic soda. Both markets have grown substantially in the last few years. North American operating rates for soda ash in 1991 were in the mid-90% range. Incremental expansions plus Tenneco's 700,000-tpy expansion (due online in Green River, Wyo., in mid-1992) are expected to bring these rates down to 93% to 94% before worldwide demand lifts operating rates into the high 90s as the economy improves within the next year or so. Without the addition of substantial new capacity, a major deficit could be seen by mid-decade.

Mill conversions replacing caustic soda with soda ash are not going quite as fast as previously anticipated, despite increasing prices for the former. When the economy improves, caustic soda supply is expected to tighten, and further attention will likely be paid to the possibility of mill conversions. Some soda ash is being used to remove SO_2 from stack gases but, again, not at the rate anticipated.

Because of the recession, overall demand for soda ash was down in 1991 from the previous year's record-breaking levels, but the U.S. pulp and paper industry did its part by expanding its demand from 146,000 tpy in 1990 to an estimated 179,000 tpy of 1991's 9.9-million-tpy North American consumption. Export sales—which rose 11%, mostly to the European Community countries—also helped to break the overall decline. Soda ash listed for $98/ton f.o.b. in Green River, although most sales were in the $80 to $93/ton range.

Sodium chlorate (chlorine dioxide). Chlorine use in the pulp and paper industry is being phased out at a rate of 5% to 10%/year, and chlorine dioxide substitution for chlorine in the bleach plant will reach 50% by 1995, according to *Chemicalweek*. However, orders in 1991 for chlorine dioxide generators that convert sodium chlorate to chlorine dioxide were half of what they were a year earlier. That was still enough, by one estimate, to raise North American capacity from 1.2 million tpy in 1990 to 1.6 million tpy in 1991. Capacity is expected to reach 1.8 million tpy in 1992, although no significant expansions are set thus far for 1993 and beyond. One supplier stated that this still represents an overcapacity that will last for the next year or two before flattening out.

CONSUMPTION OF PULPING AND BLEACHING CHEMICALS BY THE U.S. PULP AND PAPER INDUSTRY

(000 short tons)

Chemical	1989	1990	1991	1992	1993	1994
Chlorine	1,390	1,300	1,185	1,060	1,000	910
Sodium chlorate	540	660	765	845	880	895
Hydrogen peroxide	68	72	81	98	106	109
Oxygen	112	135	171	221	242	251
Caustic soda	2,300	2,275	2,280	2,240	2,210	2,230
Soda ash	126	146	179	203	203	215
Others	350	352	353	357	368	355

Source: American Paper Institute

The U.S. paper industry's 1990 consumption of sodium chlorate at 660,000 tpy was more than 22% greater than in 1989, and a jump to an estimated 765,000 tpy in 1991 represented a further 16% increase, according to the API report. Chlorine dioxide substitution will continue to be popular, particularly in older mills, where oxygen processes are thought to be more difficult to retrofit. However, many believe its days as a bleaching agent may also draw to a close, perhaps by the end of the decade.

Hydrogen peroxide. Hydrogen peroxide is finding increasing uses in kraft pulp and mechanical pulp bleaching as well as recycled fiber bleaching. Both hydrogen peroxide and peroxygens are the beneficiaries of the chlorinated organics issue.

Total North American demand for hydrogen peroxide for all applications reached 660 to 680 million lb in 1991. The U.S. pulp and paper industry consumed an estimated 81,000 tpy (162 million lb) in 1991, an increase of 12.5% above 1990's 72,000 tpy.

Producers such as Atochem, Degussa, FMC, Eka Nobel, Interox, and Kemira in the U.S. and Du Pont and Oxychem in Canada have planned new plants and expansions of old ones to add 450 million lb of capacity by early 1992 and a further 100 million lb by mid-1993. These plans may be somewhat ambitious, as it will probably take another three or four years of increasing demand to catch up with the expansions. Even in 1991, the oversupply had already had an impact, dropping prices about 10% in the third quarter. Textile-grade hydrogen peroxide dropped from 43.5¢/lb to 40¢/lb on a 70% basis in that period.

Like hydrogen peroxide, peroxygens, such as persulfates and peracetates, may find a growing market in the pulp and paper industry—in particular for dye removal in the recycling arena. Although these chemicals are more expensive than their chlorinated counterparts, they are claimed to be more user-friendly and have no chlorinated effluents associated with them. On the other hand, it is said that hypochlorite used with mixed-waste secondary fiber containing a substantial amount of mechanical pulp operates at a high pH and has a potential for alkali darkening of the pulp and some chloroform generation.

Oxygen and ozone. Oxygen consumption is rising in the paper industry as more mills add oxygen to bleaching extraction stages and employ oxygen delignification systems. Oxygen is also used in mill effluent treatment, recycling, and white liquor oxidation. Thanks to recent technical advances making a wide range of production rates economically feasible, onsite mill production of mostly noncryogenic oxygen is now augmenting supplies of liquid oxygen from regional cryogenic production facilities.

Ozone too has a lot of potential in delignification, bleaching, and end-of-pipe effluent treatment. Pulp producers will be keeping an eye on Union Camp Corp., which is bringing an ozone-based bleach plant online at its Franklin, Va., paper and board mill. Based on current interest, ozone is expected to be used in several mills in the near future, and some industry observers predict more than 50 installations will take place in the next five to seven years. It is expected that ozone facilities will be fed by oxygen rather than air; hence, an onsite ozone plant will significantly increase a mill's oxygen requirements.

According to the API survey, oxygen consumption by the pulp and paper industry rose 26.7%, from 135,000 tpy in 1990 to 171,000 tpy in 1991, with data for 1992 indicating a further increase of more than 29%. The projected increase to 251,000 tpy by 1994 represents a growth of more than 124% over 1989 levels.

Papermaking chemicals. Alum is used in acidic papermaking to precipitate rosin size onto pulp to give the finished paper water resistance. Alum sales have been depressed in the wake of the industry's conversion from acidic to alkaline papermaking processes—a trend that is approximately 40% complete, according to *Chemical Marketing Reporter*.

Titanium dioxide (TiO_2) is a white pigment used as a coating and filler to improve paper brightness and opacity. Paper industry consumption of TiO_2 reached nearly 300,000 tpy in North America in 1991. Demand growth in this sector is fairly slow, held back by the weak economy and the growing popularity of alkaline sizing. Nevertheless, TiO2 capacity is scheduled to grow, with producers such as Du Pont, Tioxide, and SCM Chemicals planning expansions. Total U.S. TiO_2 pigment capacity is expected to jump 500,000 tpy in 1991-95. The new capacity is likely to lead to overcapacity, as production in 1990 reached just 1 million tpy.

Calcium carbonate—another coating and filler—has benefitted from the move to alkaline papermaking. It has grown as producers use it as a less-expensive replacement for some fiber. It is also stealing some of kaolin clay's thunder as precipitated calcium carbonate (PCC) production becomes increasingly available onsite at paper mills. Pfizer, the market leader in PCC, has headed this movement and continues to install more of these satellite PCC units. And Omya, the dominant domestic producer of ground calcium carbonate, expects to have a new plant online by mid-1992 in Sylacauga, Ala. Calcium carbonate consumption in the North American paper industry is expected to grow from 732,000 tpy in 1989 to 1.9 million tpy in 1994, said *Chemical Marketing Reporter*.

Calcium carbonate is estimated to hold about 40% of the filler market, with kaolin clay holding about 50%. Kaolin consumption—which currently is growing only 2%/year—rose strongly in the late 1980s with the growth in printing and writing papers. This was spurred on by increased advertising, a rise in the number of magazine publications, and growth in four-color, high-quality printing, according to minerals analysts Roskill Information Services. On the other hand, the recession and the move to alkaline papermaking have dampened kaolin growth. Planned supply expansions—including Ekaton Industries' development of a deposit in Saskatchewan—should keep supplies fairly loose over the next few years.

WORLD REVIEW

For the eighth consecutive year, the world's output of paper and board reached a new record high—but just barely. After a considerable slowdown in growth in 1989 compared with 1988, the rate slowed yet further in 1990: world production of paper and board increased by a modest 2.3% to total 238,781,000 tons.

This growth rate was not expected to improve in 1991. Although Asia still seemed to be booming, riding out the storm of economic recession had become a more common motto for many forest product companies in North America and Western Europe than setting new records. With the difficulties of economic restructuring in the Eastern European countries added to the equation, production was likely to grow only slowly in 1991, if at all.

World pulp production in 1990 failed to match its 1989 record, and demand for recycled and nonwoodfiber alternatives continued to rise. Total pulp output fell by 1.8% to 160,649,000 tons in 1990 from 163,610,000 tons in 1989. Pulp accounted for around 67% of the paper and board industry's total furnish requirements in 1990, compared with 70% in 1989.

Per capita consumption of paper and board managed a marginal rise from its 1989 level, up from 44.6 kg in 1989 to a new record high of 44.8 kg the following year. Total apparent consumption rose 2.1% to 237,107,000 tons.

Paper and board producers continued to trade increasing amounts of their output on international markets. Imports rose at a faster rate than in 1989, up 4.8% to reach 54,615,000 tons. Thus, 22.9% of all paper and board produced was traded across a national boundary in 1990.

However, reflecting the more depressed nature of the pulp market, pulp imports and exports fell. Imports were down to 25,161,000 tons, compared with 26,252,000 tons in 1989.

Exports and imports were again almost in balance. For paper and board, the gap was 1.67 million tons, while for pulp, the gap was just 72,000 tons.

Scattered performance. As in 1989, Asia continued to outstrip the modest output growth rates of Western Europe and North America in 1990. Political and economic instability in Eastern Europe were reflected in a fall in production and had an adverse effect on total European output figures. In addition, the start of an economic downturn in the West and the prelude to the Gulf War—which generated an atmosphere of business uncertainty—did the industry few favors.

Latin America continued to show a healthy growth in production and consumption, although not at the pace of its Asian counterparts. After registering a small increase in production in 1989, Africa's output of paper and board rose slightly again in 1990. Although many countries in this continent continue to be plagued by political turmoil and natural disasters, modernization and new projects may also lie ahead.

In Western Europe, growth was marginally slower than in 1989, but output rose enough to tip it over the 60-million-ton mark. Production increased by 3.1% to 61.6 million tons. West Germany, the continent's biggest producer, continued its healthy growth of the previous year with production up 4.5% to over 11.8 million tons. Apparent consumption rose 10.6%, although in reality much of the rise was in the form of products converted in West Germany and exported to East Germany. France too raised its output by 4.5% to total a national record of over 7 million tons.

The Nordic countries remained on the upward trend for paper and board production, but pulp producers suffered serious problems as costs rose and market prices plummeted during the course of the year. Output of paper and board from Finland, Norway, and Sweden combined grew 1.6% to 19.2 million tons, while pulp production fell 3.2% to 20.9 million tons.

Dramatic political and economic change in Eastern Europe has had a significant effect on pulp and paper production in the region. Accurate information is now becoming available, but it is still difficult to give precise data on the industry's performance. Paper and board output is estimated to have fallen 13%, from 18 million tons to 15.6 million tons, in 1990. Pulp production fell to 11.6 million tons from 14.5 million, a drop of around 20%.

Many reasons were behind this poor performance. First, economic reform removed price controls from goods and services, in some cases dramatically reducing the purchasing power of the populations of these countries. These countries also ran short of hard currency with which to buy wood, pulp, chemicals, and other raw materials.

But perhaps the biggest reason for the collapse of output in Eastern Europe was the dissolution of the Comecon trading block of seven countries. This left the countries with no markets for their goods. With domestic demand depressed, there was little alternative but to shut down mills.

In the longer term, the Eastern European countries could enjoy better fortunes. The foundations are being laid to privatize, modernize, and attract foreign investment into the industry. New investment is a question of time and the installation of politically stable governments and institutions.

Asian stars. In contrast to Eastern Europe's performance in 1990, Asia's super-producers (excluding Australasia) continued to enjoy substantial economic growth, resulting, yet again, in a record-high paper and board output of about 57 million tons.

As expected, Rep. Korea proved to be among the fastest-growing producers, registering an increase in paper and board production of around 12.5%, at over 4.5 million tons. After a sluggish 1989, Taiwan did even better in terms of improving its performance on the previous year: output increased by 9.7% to sail comfortably above 3.3 million tons.

These countries still have a fair way to go before they catch Asia's most important producer and consumer. Japan, despite a gathering world economic slowdown, produced almost half of Asia's paper and board in 1990, or just over 28 million tons, a rise of 4.8% on its 1989 output figure. The country is also Asia's largest paper and board consumer by far, consuming over 28 million tons of paper and board in 1990.

Asia's rising stars—Indonesia and Thailand—also enjoyed a successful 1990. In the case of Indonesia, paper and board output rose almost 25%, and the nation is clearly on its way to becoming one of the major industry producers of the East. Thailand improved upon its already-substantial growth, encouraged by growing domestic demand. Output rose 14% to 877,000 tons.

People's Rep. China's official statistics also reflected growth in output, with paper and board production setting a record of 13.7 million tons, up 2.8% from 1989. That result will surprise many observers since China experienced a profound recession after the political unrest of mid-1989. In fact, output was expected to have fallen in 1990 to around

WORLD'S TOP 20 PRODUCING AND CONSUMING COUNTRIES, 1990

PAPER AND BOARD PRODUCTION (000 metric tons)			PULP PRODUCTION (000 metric tons)			PER CAPITA CONSUMPTION (lb/year)		
Country	1990	% change 1990/89	Country	1990	% change 1990/89	Country	1990	% change 1990/89
1. U.S.	71,519	2.7%	1. U.S.	57,214	1.7%	1. U.S.	687	2.5%
2. Japan	28,086	4.8	2. Canada	22,835	-3.7	2. Finland	616	31.7
3. Canada	16,466	-0.7	3. Japan	11,328	3.1	3. Fed. Rep. Germany	510	10.4
4. People's Rep. China	13,719	2.9	4. Sweden	9,914	-4.1	4. Sweden	509	0.7
5. Fed. Rep. Germany	11,873	4.5	5. People's Rep. China	9,500e	2.2	5. Japan	503	2.5
6. U.S.S.R.	10,100	-8.2	6. Finland	8,886	-2.6	6. Canada	475	-3.3
7. Finland	8,958	2.5	7. U.S.S.R.	8,380	-17.0	7. Switzerland	473	-0.4
8. Sweden	8,426	0.8	8. Brazil	4,453	-1.1	8. Belgium	463	6.2
9. France	7,049	4.3	9. Fed. Rep. Germany	2,339	-3.3	9. Denmark	453	0.3
10. Italy	5,601	-0.4	10. France	2,200	-3.2	10. Netherlands	448	-0.1
11. Brazil	4,844	0.3	11. Norway	2,169	-0.9	11. Singapore	416	n.a.
12. U.K.	4,824	7.3	12. South Africa	1,865	1.4	12. New Zealand	372	6.1
13. Rep. Korea	4,524	12.6	13. Spain	1,542	-9.7	13. Austria	367	8.1
14. Spain	3,445	0.0	14. Austria	1,460	-2.8	14. Australia	363	-4.1
15. Taiwan	3,337	9.7	15. Portugal	1,449	-2.2	15. Luxembourg	362	1.7
16. Austria	2,932	6.5	16. New Zealand	1,364	8.3	16. U.K.	360	-3.0
17. Mexico	2,871	4.9	17. Czechoslovakia	1,117	-2.2	17. Taiwan	359	3.1
18. Netherlands	2,742	6.7	18. Australia	1,029	-3.0	18. France	342	3.8
19. India	2,295	5.0	19. India	900	2.3	19. Norway	335	5.9
20. Australia	2,011	2.9	20. Chile	805	-4.3	20. Italy	266	3.2

e = Estimate.
n.a. = Not available.
Source: *Pulp & Paper International*

12.2 million tons. However, it now seems that China's myriad mills not only maintained 1989's output level but also added an extra 400,000 tons to production. Per capita consumption was constant at 12.6 kg.

Other highlights of Asia were Turkey, where output rose 12% to 920,000 tons in 1990, and the Philippines, where output is thought to have grown by 17.6% to 448,000 tons.

The Indian subcontinent also had a relatively good year in 1990. India's output of paper and board rose toward 2.3 million tons, while Pakistan and Bangladesh maintained the output levels of 1989.

Asia's bleakest spot was the Middle East, where Iraq's invasion of Kuwait in August and the subsequent United Nations trade embargo were thought to have cut output in these two countries in half compared with 1989. Neighboring countries also began to feel the shock waves from the Gulf crisis toward the end of the year.

Australasia had a reasonable, if not spectacular, year, although growth in output slowed from 7.8% to 4%. The region made 2.8 million tons of paper and board, bringing Asia and Australasia's combined total close to the 60-million-ton mark—not far off that of total West European production.

Canada and the U.S. between them had a year similar to the previous one; North American pulp and paper and board output rose, but by only 0.1% and 2%, respectively, to 80 and 87.9 million tons. Combined output rose thanks to U.S. performance since Canada's production of both pulp and paper and board fell in 1990 by 3.7% (to 22.8 million tons) and 0.7% (to 16.5 million tons), respectively.

North America remains the largest producing continent in the world, but it saw a significant fall in its world market share in 1990. From controlling 49.9% of output in 1987 and 48.8% in 1989, North America produced a considerably lower 37% of the world's paper and board in 1990. Nevertheless, the U.S. is by far the world's biggest paper and board producer, making no less than 30% of the total output, or 71.5 million tons.

Latin America back on track. Latin America's main papermakers improved production in 1990, indicating that some countries' tough economic measures could now be leading the region back on the road to recovery. Paper and board output increased by 3% to 10,818,000 tons—a modest rise but a considerable improvement on the 0.8% fall of the previous year.

Of the main producers, Mexico showed the healthiest growth in paper and board output, up 5% to 2.87 million tons. And increasingly liberal trade with North America and restructuring within the industry seem likely to encourage positive growth over the next few years.

Brazil also registered a slight increase in output at 4.84 million tons, although domestic consumption stagnated at 4.1 million tons. Argentina's producers failed to emerge unscathed from a chaotic economy and subsequent weakness in domestic demand. Consequently, production fell almost 2.5% to 926,000 tons.

Other producers, noticeably Colombia and Venezuela, made steady progress and may stand to gain new markets if, as planned, trade barriers among the Andean countries are removed in the coming years.

Latin America's pulp output was down in 1990 by around 100,000 tons, to 7.28 million tons. Brazil, Mexico, and Chile all registered a slight negative growth in this area. Brazil's output fell from 4.5 million to 4.45 million tons. Mexico produced 200,000 tons less than in 1989, at 722,000 tons. This figure matched Argentina's output, which was unchanged from the previous year.

Both pulp and paper production in Africa rose slightly in 1990 due mainly to the region's dominant producer, South Africa. The latter is thought to have increased its output of pulp and paper to 1.86 and 1.9 million tons, respectively, although no official figures are yet available. Taken as a whole, Africa's paper and board output amounted to 2.76 million tons, compared with 2.73 million in 1989.

As far as South Africa is concerned, it is not yet clear what effect the major political changes occurring in the country will have on the pulp and paper industry. However, it is clear that the domestic economy is currently depressed, driving producers increasingly to export markets.

AFRICA

Africa's pulp and paper industry is showing few signs that it is going to improve its output much in the foreseeable future. The output of the entire continent is less than that of Taiwan. Only South Africa has a significant industry, and it makes nearly 70% of Africa's paper and board. Output meets 77% of the continent's consumption, the lowest level of all the continents by a significant margin.

Egypt produces more than 200,000 tpy of paper and board, while Kenya and Morocco have small, stable papermaking industries of over 100,000 tpy. Kenya enjoyed a fairly satisfactory 1990 and expects domestic production to increase further. Algeria also has a 100,000-tpy production capacity, but output ran well below it in 1990—although there too the prospects are reasonable.

Nigeria has a rated production capacity of more than 200,000 tpy of paper and board but achieves only about 50% of that (and just 30% in 1990). General problems are lack of raw materials and imported spare parts and an often unreliable infrastructure and power supply.

In contrast, Zimbabwe's small industry is running fairly smoothly. A new mill making paper from cotton linters started in 1991, and further expansion is planned. Meanwhile, Swaziland's Usutu market pulp mill continues to make over 100,000 tpy of unbleached kraft pulp.

After several good years, the continent's biggest paper industry had a tougher time in 1990 and 1991. In the grip of recession and political turmoil, South Africa's domestic growth has stagnated, and some papermakers complain about rising uncoated woodfree paper imports, adding to downward price pressures.

Meanwhile, international markets for all of the industry's commodity grades for export—newsprint, kraft liner, and market pulp—have seen weak pricing due to worldwide overcapacity and slower demand than in recent years. One result is almost no major capital investment plans by paper and board mills. Although several are carrying out paper machine rebuilds and upgrades, only one possible new machine was planned as of late 1991.

However, one of the two dominant companies, Sappi, is expanding capacity by 100,000 tpy at its Saiccor Pty Ltd. dissolving pulp mill, already the world's biggest, and it is adding capacity to the Usutu pulp mill in Swaziland, mentioned earlier, which it owns.

Both leading companies, Sappi and Mondi Paper Co. Ltd. (which is part of Anglo American), are looking overseas for acquisitions, in part because of the lack of strong domestic growth. In 1990, Sappi bought five U.K. paper mills, while more recently Mondi bought a 49% share in a big Austrian woodfree papermaker, Neusiedler AG. Both acquisitions also mean the companies can tie some of their domestic market pulp to their new foreign paper mills.

Both are looking for further acquisitions. For example, Mondi in mid-1991 was considering the possible purchase of a share in the Soporcel market pulp mill in Portugal.

The longer-term prospects for paper demand growth at home in South Africa, however, could be considerable in the ideal scenario: the transfer to multiracial government is peacefully completed; trade sanctions are lifted; the new government follows a free-market course, bringing in foreign investment; and the standard of living and, hence, paper consumption rises nationwide.

ASIA/AUSTRALASIA

Recognition that Asia, particularly the Pacific Rim, is the fastest-growing sector of the pulp and paper industry is now widespread. It maintained that position in 1990, although production growth slowed from previous years. The simplest measure of the dynamism of Asia is that its output of paper and board from 1983 to 1989 increased by an average of 8% annually, while the average annual increase in the world's total output was 5%. In 1990, both fell below this average; Asia's output rose by 5.9% to nearly 60 million tons, while the world's increased by 2.1% to 239 million. The consequence is that Asia's share of total world output is rising steadily. It made one-quarter of the total for the first time in 1990, compared with 19.5% in 1983.

Asia and Australasia still do not make enough to cover their apparent consumption of paper and board. In 1989, for example, output covered 91% of consumption, simply comparing total tonnages. The rapid rise in demand for paper is one result of the economic successes of the region, particularly Taiwan, Rep. Korea, Singapore, and Hong Kong. But most of all the growth is due to Japan, the world's second biggest paper-producing nation, which makes 47% of the total. It is worth noting that its average annual increase over 1983-89 was 6.4%, below the average for Asia/Australasia as a whole. However, output growth accelerated in the late 1980s and set record highs each year throughout the decade. In line with the worldwide trend, output growth slowed in 1990 to 4.8%.

Japan's paper industry ran into problems in 1990. While demand for pulp and paper increased, severe production overcapacity, particularly in the woodfree paper sector, led to excess supply and a slump in market prices, resulting in lower earnings. Helped by a weaker yen, some of this excess supply was exported such that exports jumped 67%, although they still accounted for just 3% of output. Imports dropped by 12% to about 1 million tons due to the weak market conditions in Japan; most were concentrated in newsprint and other mechanical printing papers and kraft liner.

The short-term prospect is not good. Production capacity, particularly in printing and business papers, continues to rise, while the economy may well slow, leading to weaker domestic paper demand. Lower operating rates are therefore expected to continue, and in 1991, one of the leading paper producers was seeking industry-wide agreement to delay or cancel planned new capacity.

Rep. Korea and Taiwan, the third and fourth biggest producers in Asia, generally had a much better year than Japan, both enjoying a recovery in output from an unhappy 1989, although company profits in Taiwan were still affected by mediocre sales and overcapacity. For Rep. Korea, 1990 brought the industry universal improvement in nearly every sector, and its remarkable growth rate (averaging 13%/year from 1983 to 1989) is expected to continue in the 1990s with output reaching 12 million tons by 2000, compared with 4.5 million tons in 1990.

People's Rep. China is the fourth biggest paper-producing nation in the world. Its declared output in 1990 came as a surprise to many observers. Due to the problems of mid-1989, it was thought that paper output would have dropped in line with the apparently more difficult economic conditions. Some Chinese sources were forecasting output of about 12 million tons (which would have still made it fourth biggest). The total was 13.7 million tons.

This could be a result of an economy that was in fact healthier than many anticipated due to continuing growth of companies not controlled by the state. While it must be difficult to collect accurate figures from 5,000 paper and board mills and some 8,000 pulp mills, China has undoubtedly increased its production tremendously in the last decade, doubling it from 6.7 million tons in 1983 to 1990. With its enormous population, it is the great hope of the future for many papermakers, both domestic and foreign. And it is beginning to raise its self-sufficiency in fiber with reforestation programs and joint-venture pulp mills with foreigners, though nonwoods and wastepaper still provide most of its fiber, along with imported woodpulp.

The shortage of fiber is indeed a problem throughout much of Asia. Comparing gross tonnages in a simplistic way, pulp output, both wood and nonwood, meets about 80% of the region's needs for papermaking. And it is heavily dependent on wastepaper; wastepaper consumption as a proportion of paper and board output is nearly 50%, compared with about 35% for the world. Some key countries are heavily dependent on imported fiber, much of which comes across the Pacific. Taiwan, for example, used 3.4 million tons of wastepaper in 1990 (more than its entire paper and board output), of which 1.2 million was shipped from the U.S. Plans in the U.S. to raise the recycled content of its paper must be very worrying in the long term for countries, such as Taiwan, that depend on Americans not reusing too much waste.

Part of the answer to this fiber shortage lies in the vast pine plantations of New Zealand and Indonesia, the rising star of this industry. Indonesia has the forest resources, and its industry's capital investment plans are big. Paper and board production growth averaged 20%/year in the 1980s and reached 25% in 1990. The country plans to increase paper capacity to 5 million tpy by the year 2000 and pulp capacity to 3.8 million tpy. While it will continue to import wastepaper and chemical softwood pulp, it expects to export 1 million tpy of hardwood pulp by 2000. Plantations of pine and hardwoods, such as eucalyptus, are spreading, mostly in Sumatra and Kalimantan. It is to be expected that Indonesia will climb quickly up the list of top producers from its current twenty-third place.

Less likely to climb as fast are India and Australia, at nineteenth and twentieth, respectively. India's industry has long suffered from the vagaries of its economy, restrictions on imports of raw materials and machinery, and a shortage of foreign currency and domestic fiber resources. Nevertheless, sales and market prices improved in 1990. Greater use is being made of nonwood fibers, particularly bagasse for newsprint, and improved wastepaper recovery seems likely. India has a large domestic market, ready for greater per capita consumption of paper, provided industry production, in general, and education continue to improve.

Australia too is planning more nonwood pulp capacity, straw pulp in this case, and greater wastepaper recovery. Several new mills and paper machines are planned, although they will face tough environmental restrictions. Imports, which provide about one-third of Australian consumption, are expected to drop from the current 1 million tpy level due to these expansion projects.

Thailand's demand for paper and board has risen with its industrialization, and its paper mills are hard put to meet domestic demand. Although growth in output is expected to slow in the future, it will be down from about 12% to a still healthy 7%/year. Thailand is short of fiber and imports a large amount of pulp and wastepaper. However, plantations, notably of eucalyptus, are under way to replace its sadly depleted forests.

The vast population of Asia, with its increasing disposable income and growing per capita consumption of paper, is seen as offering the biggest opportunity for the world's paper industry. However, recent events have also focused attention on the huge potential growth in paper demand from Eastern Europe and the republics of the U.S.S.R.

EUROPE

Europe's pulp and paper producers faced a mixed year in 1990. Paper and board output rose to a record high of 61.7 million tons in the countries of the West (including the Nordic countries), an increase of 3.1% over 1989. But the Eastern European nations, whose output had been stagnating since 1986, saw their production collapse by 14.8% to 15.3 million tons. Output of the Eastern European countries is expected to slump further, as noncompetitive mills, exposed to competition from the West, are idled or shut down. Western Europe, meanwhile, can expect further growth in production levels, although the rate of growth will be much slower than that of previous years.

Paper and board output among the 12 European Community nations rose by 3.6% to 38.2 million tons in 1990. The picture is dominated by Western Germany, France, Italy, and the U.K.

West Germany was the continent's main engine for growth for many years. With a paper and board output of 11.9 million tons, up by 4.5% from 1989, it was the fifth biggest producer in the world in 1990, leapfrogging the U.S.S.R. Reunification of the country at the end of the year created a massive demand for printed and packaged goods in the former East Germany, and most of this tonnage was supplied through West Germany, keeping paper markets much tighter than they otherwise would have been. West German imports soared by 15.8% to 6.8 million tons, as paper and board was sucked in by printers and converters. Most of the extra tonnage was in turn exported to East Germany as finished products. In 1991, the East German consumer boom gradually slowed, and consumption growth was expected to decline as the united country struggled with the economic costs of unification.

France is experiencing a renaissance in its paper industry, with expansions and acquisitions dominating the scene. Its paper and board output was just over 7 million tons (+4.3%)—the first time that barrier has been broken. With several new machines coming onstream over the next year or two, France's output can be expected to climb even higher in the future. Mergers and takeovers have been a major feature of France's industry in the past few years. The EC's largest paper company in terms of sales was created by the merger of Arjomari with the U.K.'s Wiggins Teape plc; Finland's UPM started up a new newsprint mill at Strasbourg in France; another Finnish company, Kymmene, took control of newsprint and lightweight coated paper producer, Chapelle-Darblay; and Norway's Norske Skogindustrier A/S was scheduled to start up a greenfield newsprint mill at the end of 1991.

Italy's industry has been much less open to internationalization, but the process is slowly starting to occur. Sweden's SCA acquired Italcarta, a major test liner producer, while Saffa Group of Italy merged with Spain's Sarrio to form one of Europe's most important carton board producers. Output of paper and board in Italy was stagnant in 1990 at 5.6 million tons.

The U.K., meanwhile, despite the onset of a severe domestic recession, managed to raise output by 7.3% to 4.8 million tons, mainly by virtue of a successful export campaign. In fact, exports passed the 1-million-ton mark for the first time ever.

The EC continues to be the world's major pulp importer. Out of a consumption of 18.4 million tons of pulp in 1990, only 9.6 million tons were produced in the region.

The Nordic nations—Finland, Sweden, and Norway—are having a rough ride in the 1990s. The economics of producing pulp and paper in Sweden and Finland worsened in the 1980s due to soaring wood and labor costs. But the boom in paper consumption in Europe as a whole kept mar-

Country	Population (1,000)	Number of mills		Capacity (1,000 tons)		Per capita (kg)	Apparent consumption (1,000 tons)				Production (1,000 tons)			
		P&B	Pulp	P&B	Pulp		P&B		Pulp		P&B		Pulp	
							1989	1990	1989	1990	1989	1990	1989	1990
EUROPE														
Belgium	9,948	14	3	1,250	463	210.1	1,966	2,090	790	784	1,167	1,198	467	477
Denmark	5,200	6	1	340	105	205.4	1,051	1,068	142	151	328	335	105	102
France	56,500	149	21	7,400	2,670	155.0	8,363	8,755	3,668	3,652	6,760	7,049	2,273	2,200
German Fed. Rep.	62,900	174	33	13,042	2,640	231.5	13,169	14,560	5,771	5,669	11,361	11,873	2,418	2,339
Greece	10,256	25	2	500	75	61.1	652	627	221	210	375	347	40	35
Ireland	3,642	1	0	40e	0	97.7	318	356	0	0	33	35	0	0
Italy •	57,550	326	19	6,300	1,000	120.8	6,739	6,954	2,884	2,731	5,621	5,601	771	676
Luxembourg	378	0	0	0	0	164.0	60	62	0	0	0	0	0	0
Netherlands	15,009	32	2	2,894	198	203.2	3,010	3,050	786	817	2,570	2,742	167	192
Portugal	10,337	90	8	833	1,450	73.0	699	755	486	454	740	781	1,482	1,449
Spain	39,600	156	26	3,950	1,750	109.6	4,110	4,341	1,480	1,403	3,445	3,445	1,707	1,542
United Kingdom	56,700	91	6	5,360	684	163.5	9,600	9,273	2,577	2,523	4,495	4,824	446	595
EEC	**328,020**	**1,064**	**121**	**41,909**	**11,035**	**158.2**	**49,737**	**51,891**	**18,805**	**18,394**	**36,895**	**38,230**	**9,876**	**9,607**
Finland	4,950	44	45	9,740	9,850	279.2	1,424	1,382	7,549	7,504	8,736	8,958	9,119	8,886
Norway	4,200	19	23	1,925	2,510	152.1	605	639	1,620	1,659	1,790	1,820	2,189	2,169
Sweden	8,500	52	53	9,065	11,205	230.7	1,914	1,961	7,564	7,375	8,362	8,426	10,338	9,914
Nordic	**17,650**	**115**	**121**	**20,730**	**23,565**	**225.6**	**3,943**	**3,982**	**16,733**	**16,538**	**18,888**	**19,204**	**21,646**	**20,969**
Austria	7,712	31	11	3,384	1,703	166.4	1,172	1,283	1,653	1,661	2,754	2,932	1,502	1,460
Iceland	256	0	0	0	0	101.6	26	26	1	0	0	0	0	0
Malta	351	0	0	0	0	71.2	25	25	0	0	0	0	0	0
Switzerland	6,751	29	6	1,350	364	214.5	1,437	1,448	630	630	1,259	1,295	328	341
Other W. Europe	**15,070**	**60**	**17**	**4,734**	**2,067**	**184.6**	**2,660**	**2,782**	**2,284**	**2,291**	**4,013**	**4,227**	**1,830**	**1,801**
Total W. Europe	**360,740**	**1,239**	**259**	**67,373**	**36,667**	**162.6**	**56,340**	**58,655**	**37,822**	**37,223**	**59,796**	**61,661**	**33,352**	**32,377**
Albania	3,255	4	4	15e	15e	4.6	15	15	10	10	10	10	10	10
Bulgaria	9,005	15	9	520e	260e	28.3	410	255	270	180	350	215	220	160
Czechoslovakia	15,675	37	19	1,400	1,120	77.8	1,234	1,219	988	971	1,312	1,323	1,142	1,117
German Dem. Rep.	16,490	43	1	850	160	43.9	1,413	724	849	354	1,360	674	669	244
Hungary	10,100	9	4	588	72	55.1	653	557	245	200	504	443	73	67
Poland	38,386	42	17	1,700	1,005	22.0	1,340	846	1,038	579	1,397	1,064	860	522
Romania	23,100	15	17	905	953	22.3	623	514	719	484	710	546	665	445
USSR	288,239	174	54	11,500e	11,000e	33.7	10,255	9,725	9,230	7,930	11,000	10,100	10,100	8,380
Yugoslavia	23,000	27	16	1,450	900	47.6	1,095	1,095	968	764	1,380	1,260	846	737
E. Europe	**427,250**	**366**	**141**	**18,928**	**15,465**	**35.0**	**17,038**	**14,950**	**14,317**	**11,472**	**18,003**	**15,635**	**14,585**	**11,682**
Total Europe	**787,990**	**1,605**	**400**	**86,301**	**52,152**	**93.4**	**73,378**	**73,605**	**52,139**	**48,695**	**77,799**	**77,296**	**47,937**	**44,059**
NORTH AMERICA														
Canada	26,584	115	34	18,915	26,525	215.3	5,899	5,724	15,645	15,198	16,583	16,466	23,708	22,835
USA	249,632	538	214	76,241	59,425	311.4	76,123	77,732	55,131	56,296	69,660	71,519	56,244	57,214
North America	**276,216**	**653**	**248**	**95,156**	**85,950**	**302.1**	**82,022**	**83,456**	**70,776**	**71,494**	**86,243**	**87,985**	**79,952**	**80,049**
ASIA														
Afghanistan	15,808	0	0	0	0	0.2	3	3	0	0	0	0	0	0
Bahrain	466	0	0	0	0	15.0	6	7	0	0	0	0	0	0
Bangladesh	120,000	9	7	135	126	1.4	148	169	124	120	124	133	99	100
Bhutan	1,511	0	0	0	0	0.7	1	1	0	0	0	0	0	0
Brunei	294	0	0	0	0	10.2	3	3	0	0	0	0	0	0
Burma	41,621	3	2	31	30e	1.2	48	48	29	29	28	28	29	29
Cambodia	8,227	0	0	0	0	0.2	2	2	0	0	0	0	0	0
China, Peo. Rep.	1,143,330	250	176	15,500e	11,000e	12.6	13,969	14,429	9,767	9,838	13,333	13,719	9,300	9,500
Cyprus	700	1	0	10e	0	101.4	52	71	2	3	4	4	0	0
Hong Kong	5,812	2	0	110	0	114.1	604	663	0	0	40	95	0	0
India	843,000	320	215	3,014	1,450e	3.1	2,440	2,575	1,270	1,050	2,185	2,295	880	900
Indonesia	179,140	42	16	1,716	1,108	7.7	1,076	1,372	631	737	1,155	1,438	510	701
Iran	55,000	6	2	315	188	10.3	426	565	80	140	142	211	65	90
Iraq	17,911	2	2	144	90e	8.1	242	145	69	40	102	75	10	10
Israel	4,819	5	0	200	0	104.4	472	503	62	62	178	193	0	0
Japan	123,600	444	58	30,728	13,813	228.3	27,442	28,218	14,340	14,203	26,809	28,086	10,987	11,328
Jordan	3,500	3	0	18	0	20.9	61	73	5	8	12	15	0	0
Korea, Peo. Rep.	22,975	6	2	100e	80e	3.5	80	80	70	68	80	80	60	60
Korea, Rep. of	42,380	139	5	5,020	400	101.7	3,866	4,310	1,261	1,453	4,018	4,524	302	318
Kuwait	2,084	1	0	25e	0	24.5	91	51	10	7	23	12	0	0
Laos	4,047	0	0	0	0	0.2	1	1	0	0	0	0	0	0
Lebanon	2,867	3	0	50e	0	8.7	25	25	2	2	15	15	0	0
Macao	320	0	0	0	0	12.5	4	4	0	0	0	0	0	0
Malaysia	17,370	14	1	258	92e	44.6	774	774	146	147	251	251	120	120
Mongolia	2,205	1	1	10e	6e	9.1	20	20	5	5	5	5	5	5
Nepal	18,916	2	2	10e	8e	1.1	21	21	3	3	7	7	3	3
Oman	1,199	0	0	0	0	5.8	6	7	0	0	0	0	0	0
Pakistan	111,830	25	18	362	100e	2.9	317	325	104	117	161	165	57	81
Philippines	61,480	32	4	577	208	8.9	477	545	179	184	382	448	118	127
Qatar	383	0	0	0	0	28.7	10	11	0	0	0	0	0	0
Saudi Arabia	14,180	0	0	0	0	8.1	110	115	0	0	0	0	0	0
Singapore	2,700	2	0	80	0	188.9	514	510	6	6	80	80	0	0
Sri Lanka	17,000	2	2	38	26	2.0	33	34	12	14	18	19	3	6
Syria	12,525	15	15	10e	0	6.3	77	79	0	0	7	9	0	0
Taiwan	20,400	155	3	3,950e	480e	162.7	3,176	3,320	842	854	3,042	3,337	437	411
Thailand	55,900	36	3	983	153	21.3	954	1,192	276	325	766	877	164	159
Turkey	55,885	35	14	1,000e	726e	19.9	1,018	1,112	565	595	820	920	450	500
Utd Arab Emirates	1,705	0	0	0	0	44.6	75	76	0	0	0	0	0	0
Vietnam	67,452	30	1	120e	60e	1.0	66	66	40	40	60	60	30	30
Yemen	10,500	0	0	0	0	0.5	4	5	0	0	0	0	0	0
Asia	**3,111,046**	**1,585**	**549**	**64,514**	**30,144**	**19.8**	**58,714**	**61,530**	**29,900**	**30,050**	**53,847**	**57,101**	**23,829**	**24,478**

Some figures are estimates. Consumption figures are apparent consumptions only.
Peo. Rep. China has approximately 5,000 paper mills and 9,000 pulp mills. Only the 250 largest are included here.

Country	Population (1,000)	Number of mills		Capacity (1,000 tons)		Per capita (kg)	Apparent consumption (1,000 tons)				Production (1,000 tons)			
		P&B	Pulp	P&B	Pulp		P&B		Pulp		P&B		Pulp	
							1989	1990	1989	1990	1989	1990	1989	1990
LATIN AMERICA														
Argentina	32,700	100	25	1,350	871	25.5	886	833	685	621	953	926	722	722
Bahamas	235	0	0	0	0	17.0	4	4	0	0	0	0	0	0
Barbados	260	0	0	0	0	26.9	7	7	0	0	0	0	0	0
Belize	182	0	0	0	0	16.5	3	3	0	0	0	0	0	0
Bolivia	7,219	1	0	2e	0	2.9	21	21	0	0	1	1	0	0
Brazil	150,367	141	38	5,764	5,179	27.6	4,156	4,151	3,582	3,492	4,831	4,844	4,501	4,453
Chile	13,173	10	8	498	1,041	31.6	375	416	365	227	438	462	841	805
Colombia	32,500	24	5	611	283	18.8	582	610	286	288	511	534	256	245
Costa Rica	3,016	1	1	18	7	52.1	157	157	9	9	18	18	7	7
Cuba	10,500	12	4	255	110	34.8	360	365	90	97	170	170	53	60
Dominican Rep	7,213	2	0	15e	0	9.0	65	65	0	0	9	9	0	0
Ecuador	10,000	5	1	70	35e	30.1	212	301	10	14	62	68	8	12
El Salvador	5,275	3	0	50e	0	12.7	67	67	7	7	29	29	0	0
Guatemala	9,000	4	1	48	330	11.6	96	104	9	12	32	38	0	0
Guyana	755	0	0	0	0	9.3	7	7	0	0	0	0	0	0
Haiti	6,477	0	0	0	0	0.9	6	6	0	0	0	0	0	0
Honduras	5,135	0	0	0	0	12.7	65	65	0	0	0	0	0	0
Jamaica	2,500	1	0	20	0	35.2	87	88	1	1	13	13	0	0
Mexico	82,000	67	15	3,611	1,139	36.4	2,710	2,982	1,054	1,060	2,737	2,871	799	772
Neth. Antilles	189	0	0	0	0	21.2	3	4	0	0	0	0	0	0
Nicaragua	3,826	0	0	0	0	2.4	8	9	0	0	0	0	0	0
Panama	2,421	3	0	30e	0	48.7	118	118	1	2	28	28	0	0
Paraguay	4,290	3	1	11	2e	6.5	28	28	0	0	9	10	0	0
Peru	22,500	17	3	220	270	6.4	168	145	109	102	120	122	92	84
Puerto Rico	3,378	0	0	0	0	56.0	189	189	40	40	0	0	0	0
Surinam	405	0	0	0	0	17.3	9	7	0	0	0	0	0	0
Trinidad/Tobago	1,299	0	0	0	0	26.2	34	34	2	2	0	0	0	0
Uruguay	3,107	5	2	83	27e	22.2	69	69	33	34	66	66	26	26
Venezuela	19,000	12	3	839	215	36.2	632	688	223	273	525	609	88	95
Latin America	**438,922**	**411**	**107**	**13,495**	**9,509**	**26.3**	**11,124**	**11,543**	**6,506**	**6,281**	**10,552**	**10,818**	**7,393**	**7,281**
AUSTRALASIA														
Australia	17,000	21	10	2,500e	1,100	164.8	2,844	2,801	1,263	1,268	1,954	2,011	1,061	1,029
Fiji	730	0	0	0	0	17.8	12	13	0	0	0	0	0	0
New Caledonia	160	0	0	0	0	12.5	2	2	0	0	0	0	0	0
New Zealand	3,429	6	7	889	1,471	168.9	570	579	738	751	760	810	1,259	1,364
Papua New Guinea	3,985	0	0	0	0	1.5	6	6	0	0	0	0	0	0
Samoa	213	0	0	0	0	14.1	3	3	0	0	0	0	0	0
Australasia	**25,517**	**27**	**17**	**3,389**	**2,571**	**133.4**	**3,437**	**3,404**	**2,001**	**2,019**	**2,714**	**2,821**	**2,320**	**2,393**
AFRICA														
Algeria	24,700	5	3	128	106	9.3	289	230	78	73	88	87	8	2
Angola	10,166	2	1	30e	45e	1.9	19	19	15	15	15	15	15	15
Benin	4,778	0	0	0	0	0.8	4	4	0	0	0	0	0	0
Botswana	1,283	0	0	0	0	1.6	1	2	0	0	0	0	0	0
Burkina Faso	8,975	0	0	0	0	0.2	2	2	0	0	0	0	0	0
Burundi	5,459	0	0	0	0	0.5	4	3	0	0	0	0	0	0
Cameroon	12,252	0	0	0	0	0.8	10	10	0	0	0	0	0	0
Cape Verde Islds	379	0	0	0	0	2.6	1	1	0	0	0	0	0	0
Ctl African Rep	2,913	0	0	0	0	0.3	1	1	0	0	0	0	0	0
Chad	5,708	0	0	0	0	0.2	1	1	0	0	0	0	0	0
Comores	521	0	0	0	0	1.9	1	1	0	0	0	0	0	0
Congo	2,018	0	0	0	0	0.5	1	1	0	0	0	0	0	0
Djibouti	403	0	0	0	0	2.5	1	1	0	0	0	0	0	0
Egypt	54,216	18	2	220	62	10.7	493	581	105	124	216	223	53	56
Ethiopia	47,506	1	1	15	7e	0.3	21	15	8	6	11	8	4	2
Gabon	1,121	0	0	0	0	1.8	2	2	0	0	0	0	0	0
Gambia	854	0	0	0	0	2.3	2	2	0	0	0	0	0	0
Ghana	14,967	0	0	0	0	0.6	9	9	0	0	0	0	0	0
Guinea	6,875	0	0	0	0	0.7	4	5	0	0	0	0	0	0
Guinea-Bissau	996	0	0	0	0	1.0	1	1	0	0	0	0	0	0
Ivory Coast	12,513	0	0	0	0	6.4	80	80	0	0	0	0	0	0
Kenya	27,200	6	1	130	71	5.4	127	146	66	67	104	123	65	66
Lesotho	1,767	0	0	0	0	1.1	1	2	0	0	0	0	0	0
Liberia	2,554	0	0	0	0	0.4	1	1	0	0	0	0	0	0
Libya	4,497	10	0	10e	0	2.7	12	12	3	3	6	6	0	0
Madagascar	11,962	2	2	30	7	0.8	9	10	9	7	9	9	5	4
Malawi	8,403	0	0	0	0	1.9	16	16	0	0	0	0	0	0
Mali	9,340	0	0	0	0	0.1	1	1	0	0	0	0	0	0
Mauritania	2,033	0	0	0	0	2.0	4	4	0	0	0	0	0	0
Mauritius	117	0	0	0	0	59.8	6	7	0	0	0	0	0	0
Morocco	27,000	7	1	130	100	8.0	216	216	55	22	120	119	107	100
Mozambique	15,697	2	0	10e	0	0.8	17	13	0	0	2	1	0	0
Namibia	1,882	0	0	0	0	1.1	2	2	0	0	0	0	0	0
Niger	7,122	0	0	0	0	0.4	3	3	0	0	0	0	0	0
Nigeria	111,894	3	3	230	200e	2.9	320	320	95	95	70	70	35	35
Rwanda	7,260	0	0	0	0	0.6	5	4	0	0	0	0	0	0
Senegal	7,410	0	0	0	0	0.5	4	4	0	0	0	0	0	0
Seychelles	69	0	0	0	0	29.0	2	2	0	0	0	0	0	0
Sierra Leone	4,146	0	0	0	0	0.2	1	1	0	0	0	0	0	0
Somalia	7,565	0	0	0	0	0.1	2	1	0	0	0	0	0	0
South Africa	35,248	19	9	2,200	2,256	44.3	1,542	1,561	1,445	1,480	1,899	1,904	1,840	1,865
Sudan	23,979	2	0	4	0	1.1	27	26	0	0	5	4	0	0
Swaziland	700	1	1	30	180	4.3	3	3			22	25	147	130
Tanzania	27,248	2	4	69	76e	0.7	27	18	38	52	38	29	38	52
Togo	3,466	0	0	0	0	0.1	0	0	0	0	0	0	0	0
Tunisia	8,169	5	1	50e	25e	11.6	95	95	30	30	40	40	20	20
Uganda	18,360	1	0	5e	0	0.4	7	8	0	0	2	3	0	0
Zaire	35,755	1	0	4e	0	0.3	11	11	2	2	3	3	0	0
Zambia	8,000	1	0	13	0	1.8	14	14	1	1	4	4	0	0
Zimbabwe	9,741	3	2	90	42	10.0	95	97	64	64	85	87	42	42
Africa	**647,187**	**91**	**31**	**3,398**	**3,177**	**5.5**	**3,517**	**3,909**	**2,006**	**2,038**	**2,738**	**2,780**	**2,379**	**2,389**
TOTAL WORLD	**5,286,878**	**4,372**	**1,382**	**266,253**	**183,903**	**44.8**	**232,192**	**237,107**	**163,328**	**160,577**	**233,894**	**238,781**	**163,610**	**160,648**

ket prices high and masked the top-heavy cost structure of these countries. Meanwhile, the domestic economies of both countries are in deep recession.

Against this background, company profits are falling sharply, especially for those companies involved in volatile businesses, such as market pulp. The Swedish companies, which have invested heavily in acquiring EC companies, may find themselves better placed to ride out the storm than some of their Finnish counterparts. However, further rationalization of both industries seems likely in the years ahead, as the remaining medium-size companies become absorbed by the big groups.

Overall, output of pulp and paper from the Nordic region rose only 1.6% in 1990, to reach 19.2 million tons. As might be expected in the weak pulp market, pulp production fell by 3.1% to just under 21 million tons.

In Eastern Europe, all of the countries are experiencing the same problem: how to recover from years of stagnation. Per capita consumption of paper and board is low by Western European standards, at an average of around 35 kg, with the highest level being Czechoslovakia's 78 kg. To bring that level up to the Western European average of 163 kg will take a massive injection of foreign know how and money.

Under the old system of the command economy, mills produced to a plan drawn up by bureaucrats. Raw materials arrived at the mill according to a central plan, and the product was dispatched according to the same central plan to the consumer. All transactions were conducted at prices fixed by the state planners.

That system has now disappeared, but nothing has been substituted in its place. Put simply, technically competent but underfunded mills are now having to take a crash course in market economics. They must learn how to bargain for the best prices for raw materials, how to fix market prices for their products, and how to export paper of sufficient quality to sell well in the rich markets of the West.

Much will depend on the speed with which foreign partners can be brought in to provide new equity for the mills. Hungary, for example, is already well along the road to privatizing its pulp and paper industry, selling large minority interests in its brown grades sector to Austria's Prinzhorn Group, for instance. Negotiations are also under way for the sale of the country's largest printings/writings mill. Czechoslovakia is seeking foreign partners for its producers. No deals have been struck so far, but few doubt that they will be forthcoming. The country enjoys a favorable geographic position and is well placed to serve southern Germany, Italy, and Austria. All of these nations have so far shown political maturity and stability, which will help in attracting foreign equity.

Poland, meanwhile, has taken a different approach, commissioning a study of the whole pulp and paper sector and then embarking on the first wave of privatizations, including eight mills and one converter, accounting for 64% of the country's output in an average year. They were expected to be sold early in 1992 and include some of the best-known and most modern in Eastern Europe. [illegible] their comparative proximity to the German market, it [illegible] highly possible that Poland's bigger mills will enjoy a renaissance toward the end of the 1990s.

The biggest question mark hangs over the U.S.S.R. Most of this giant country's paper industry is within the borders of the Russia Republic. At present, with the country undergoing radical change in its political and social structures, output of paper and board is falling sharply. There is confusion over who owns the mills and under which law they can be privatized.

However, it must be remembered that the U.S.S.R. was the sixth largest producer in the world in 1990, making 9.8 million tons of paper and board, and the 285 million people who live in the loose confederation of states will at some point emerge as a fast-growing market before the end of the decade. Companies from the West planning investment are likely to move cautiously until the political and economic reforms have been settled. But a boom in consumption in the second half of the 1990s seems certain.

LATIN AMERICA

Latin American output of paper and board climbed by 2.5% to 10.8 million tons in 1990, the biggest rise since 1986. In fact, for the previous three years, production had stagnated at 10.5 to 10.6 million tons. Pulp production, which peaked at 7.4 million tons in 1989, fell back to 7.3 million tons in 1990, reflecting poorer world pulp markets.

The success story of 1990 was Mexico. Its paper and board output rose 4.9% on the back of 3.9% growth in GDP. Per capita consumption at 36.4 kg was a record for the

WORLD PAPER AND BOARD CAPACITY

(000 metric tpy)

	Capacity		Average annual increase (%)	
	1990	1995	1985-90	1990-95
World total	260,496	298,831	3.4%	2.8%
Developed market economies	200,235	233,174	3.4	3.1
North America	95,289	104,879	2.5	1.9
Japan	30,728	37,706	5.0	4.2
Western Europe	69,079	85,278	4.1	4.3
Oceania	3,058	3,225	1.4	1.1
Others	2,081	2,086	2.2	0.0
Developing markets	27,046	33,597	4.7	4.4
Africa	1,013	1,210	4.2	3.6
Latin America	13,528	16,964	2.0	4.6
Asia	12,505	15,423	8.1	4.3
Centrally planned economies	33,215	32,060	2.5	-0.7
Asia	13,596	13,619	9.1	0.0
Eastern Europe	6,819	5,641	0.8	-3.7
U.S.S.R.	12,800	12,800	-1.8	0.0

Source: United Nations Food & Agriculture Organization.

country, helped along by a 60% jump in imports to 279,000 tons and a fall in exports. Mexico, if its economic restructuring program is sustained, looks set to become one of the stars of the 1990s. Not only can fast growth in domestic consumption be expected but access to the mighty U.S. market will also be eased if a Free Trade Agreement with the U.S. and Canada is reached.

If Mexico's producers had a relatively good 1990, the same cannot be said of Brazil's. A severe domestic recession bit deep into company profits, and it is believed that the industry as a whole took a loss equivalent to 2.6% of turnover, compared with a profit of 6.6% the previous year. Output of paper and board was stable at 4.84 million tons, but exports rose substantially, from 917,000 to 940,000 tons. Pulp output fell back by 1.1% to 4.45 million tons.

The Brazilian government's austerity plan was introduced in March 1990 with the aim of eliminating inflation. It has had limited success and has precipitated the deepest recession of recent times. As a result, pulp-producing companies have had to postpone some major expansion projects to await the upturn. The only exception was Aracruz Celulose SA's 520,000-tpy eucalyptus market pulp expansion, which came onstream early in 1991. Despite the slowdown, it is still expected that several export-oriented greenfield mills will get the go-ahead in the coming years.

Chile continues to bolster its reputation as a major producer of high-quality radiata pine market pulps. No less than three world-class pulp mills started up in 1991. Celulosa Arauco y Constitucion's Arauco II line, Celulosa del Pacifico's new mill being built with the U.S.'s Simpson Timber, and the Santa Fe mill, owned by Shell, Scott, and Citibank, were all due online before December 1991. Santa Fe will use eucalyptus as raw material, while the others will be based on pine. Chile's low wood and labor costs plus the rising reputation of Chilean pulp mean that these mills are more able to make money than most—even at the low point of the pulp cycle.

Argentina, meanwhile, continues in the economic doldrums, with retail price inflation in 1990 of 1,350%. Output and profits fell in the paper industry. Paper and board production was down by 2.8% to 925,950 tons, while pulp production was steady at 722,000 tons. Measures taken by the government to liberalize the economy have included the reduction of import tariffs. However, the domestic industry is expected to benefit. Output of paper is predicted to rise by 350,000 tons over the next five years and production of pulp by 800,000 tons in the same period. But much will hinge on the state of the domestic economy. Low wood and labor costs may well attract foreign capital in the coming years, provided that the political and economic situation can be stabilized.

All three of the ABC countries—Argentina, Brazil, and Chile—will probably benefit if moves to set up a free trade zone in the region bear fruit. This would eliminate barriers to the free flow of pulp and paper in the region.

Elsewhere in Latin America, both Venezuela and Colombia could conceivably become important centers for investment in the future. Venezuela is also undergoing economic shock treatment. Exports are picking up as domestic demand temporarily slows down. And Venezuela has em-

WORLD PAPER-GRADE WOODPULP CAPACITY

(000 metric tpy)

	Capacity		Average annual increase (%)	
	1990	1995	1985-90	1990-95
World total	168,583	185,584	2.2%	1.9%
Developed market economies	138,981	151,353	2.4	1.7
North America	84,496	90,066	2.3	1.3
Japan	13,484	15,474	2.3	2.8
Western Europe	36,868	41,639	3.0	2.5
Oceania	2,683	2,724	0.0	0.3
Others	1,450	1,450	0.0	0.0
Developing markets	11,769	17,351	5.2	8.1
Africa	1,002	1,086	6.9	1.6
Latin America	8,029	13,083	5.0	10.3
Asia	2,738	3,182	5.2	3.1
Centrally planned economies	17,833	16,880	-0.9	-1.1
Asia	1,881	1,896	-3.2	0.2
Eastern Europe	4,317	3,349	-0.4	-5.0
U.S.S.R.	11,635	11,635	-0.7	0.0

Source: United Nations Food & Agriculture Organization.

1990 PAPER, BOARD, AND PULP PRODUCTION IN WESTERN EUROPE

(000 metric tons)

Country	Paper and board production	% change 1990/89	Pulp Production	% change 1990/89
Austria	2,932	6.5%	1,317	-3.5%
Belgium	1,199	2.4	485	3.9
Denmark	335	2.1	102	-2.9
Finland	8,953	2.3	8,764	-2.1
France	7,050	4.3	2,207	-2.9
Germany	11,856	4.4	2,233	-2.1
Ireland	35	6.1	0	—
Italy	5,589	-0.9	677	-12.2
Netherlands	2,743	6.6	190	13.8
Norway	1,820	1.7	2,063	2.1
Portugal	753	5.2	1,449	-2.2
Spain	3,445	-0.1	1,419	-9.9
Sweden	8,427	0.8	9,914	-4.1
Switzerland	1,295	2.7	341	3.6
U.K.	4,824	7.8	595	33.4
Total	61,256	3.1	31,756	-2.5

Source: European Paper Institute.

barked on major tree-planting projects to permit expansion in the late 1990s. Colombia too is considering capacity expansions. Most noticeable is a bagasse-based printings/writings mill with a capacity of 120,000 tpy, due to start up within a year or two.

Central America, excluding Mexico, however, presents a sorry tale. Demand is low, output is stagnant, and economies are in the doldrums. There is little sign of any change in the coming years.

FAO CAPACITY SURVEY

The latest capacity survey from the Food & Agriculture Organization of the United Nations indicates that paper and paperboard capacity worldwide will top 298.8 million metric tons by 1995, up from 260.5 million metric tons in 1990. While capacity rose at an average annual rate of 3.4% from 1985-90, the pace will slow to an average of 2.8%/year in the following five years. Expansion over that time will drop gradually, from a rate of 4.1% in 1990-91 to 0.9% in 1994-95.

Once again, printing and writing paper growth will lead the pack, with this sector due to expand 4.0%/year on average through 1995 to reach 90.3 million tons. Newsprint producers will increase their capacity 2.8%/year to 41.7 million tons by 1995, while the rest of the paper and board industry will grow at 2.2%/year to 166.8 million tons.

Japan, Western Europe, and the developing nations will expand the fastest from 1990-95. Eastern Europe will reverse the trend of the last five years and its paper and board capacity will contract, while the U.S.S.R. will manage to bring its own contraction to a halt.

Growth in the paper-grade woodpulp sector will reach just 1.9%/year on average from 1990-95, peaking at 2.8% in 1991-92 and then easing off to 1.4% to 1.6% in the next three years. By 1995, capacity will stand at 185.6 million tons, up from 168.6 million tons in 1990.

Producers are showing the most interest in pushing up chemical pulp capacity, achieving a 2.1%/year rise on average from 1990-95, somewhat faster than the previous five-year period. That will bring capacity to 127.3 million tons. Mechanical pulp, on the other hand, has slacked off from 3.6%/year growth in 1985-90 down to 1.9%/year for the next five years, for a goal of 48.0 million tons. Semichemical pulp will start growing, and dissolving pulp producers will slow the shrinkage in their own business. In the "other fiber pulp" category, capacity will manage to ease up just 0.5%/year on average, down from the 3.2%/year growth rate over 1985-90. But this will be enough to bring capacity in the sector to 16.0 million tons.

World market pulp capacity is due to rise from 35 million tons in 1990 to 39 million tons by 1993. North America accounted for 15.7 million tons in 1990, followed by 6.3 million tons in the Nordic countries, 3.7 million tons in the rest of Western Europe, and 2.7 million tons each in the U.S.S.R. and Latin America.

GLOSSARY OF INDUSTRY TERMS

Reprinted from *Pulp & Paper Dictionary* by John R. Lavigne (Miller Freeman Publications, 1986).

A

ABRASION RESISTANCE. Ability of a paper product to withstand abrasion. Measured by determining degree and rate that a sample loses weight under specific rubbing action of an abrading substance, such as an eraser.

ABSORBENCY. Property of pulp, paper, and its constituents and products that permits the entrainment and retention of other materials it contacts, such as liquid, gaseous, and solid substances.

AIR DRY (a.d.). Weight of moisture-free pulp or paper plus 10% moisture based on traditional assumption that this amount of moisture exists when they come into equilibrium with the atmosphere.

ALUM. Papermaking chemical commonly used for precipitating rosin size onto pulp fibers to impart water-resistant properties (when used for water treatment) to the paper. Also called *aluminum sulfate*.

ANTITARNISH PAPER. Term originally applied to higher-weight tissues used for wrapping silverware, but now used for all papers so prepared that they will not rust or discolor razor blades, needles, silverware, etc.

APPARENT DENSITY. Weight (mass) per unit volume of a sheet of paper obtained by dividing the basis weight by the caliper (thickness).

B

BASESTOCK. Paper or board to be further treated in various ways.

BASIS WEIGHT. Weight in pounds of a ream of paper, usually consisting of 480, 500, or 1,000 sheets of a specified size.

BEATER. Large, longitudinally partitioned, oval tub used to mix and mechanically "work" pulp with other ingredients to make paper.

BEATING. See *refining*.

BINDERS BOARD. Gray-colored, glazed board often used in the binding of hardcover books.

BIOLOGICAL OXYGEN DEMAND (BOD). Amount of dissolved oxygen consumed in five days by biological processes breaking down organic matter in mill effluent.

BISULFITE PULP. Pulp made by the bisulfite cooking process using bisulfite cooking liquor.

BOGUS. Product that has been made from wastepaper or other inferior materials to imitate higher-quality grades.

BOND. Class of printing/writing papers made from bleached chemical woodpulps and cotton fibers.

BONDING STRENGTH. Intralayer binding force in a multi-ply paperboard or laminate. Also refers to the degree of adherence of coating and film on a sheet and to the interfiber binding force within a sheet.

BONE DRY (b.d.). (1) Descriptive term for the moisture-free conditions of pulp paper. See *oven dry*. (2) Refers to air containing no vapor.

BOOK PAPER. Paper suitable for printing and other uses in the graphic arts industry.

BRIGHTNESS. Measure of the degree of reflectivity of a sheet of pulp or paper for blue light measured under specified standard conditions. Also called *whiteness*.

BRISTOLS. Heavy-grade papers possessing higher-than-average quality characteristics. Rigid enough to be used for announcements, invitations, postcards, etc.

BROKE. Paper trimmings or damaged paper due to breaks on paper machine and in finishing operations.

BULK. Compactness property of a sheet in relation to its weight (whose value decreases as compactness increases).

BURSTING STRENGTH. Resistance of paper to rupture when pressure is applied to a side by a specified instrument. Also called *burst*, *mullen*, and *pop strength*.

C

CALENDER. Piece of processing equipment located at dry end of paper machine, consisting of a set of rolls through which paper sheet is passed for smoothing, leveling, and gloss improvement.

CALENDER FINISHED. Paper and paperboard passed through a calender to improve surface characteristics by application of pressure, friction, or moisture.

CALIPER. Thickness of a sheet of paper or paperboard, measured under certain specifically stated conditions, expressed in units of thousandths of an inch (called "mils" when referring to paper, "points" when referring to paperboard). Also called *thickness.*

CARBONIZING PAPER. Lightweight, uncoated paper made from unbleached chemical and/or mechanical pulps and surface-coated with a carbon solvent or wax so that it takes up carbon inks and releases them under pressure, thereby duplicating the inked areas being printed.

CARBONLESS PAPER. Copying paper that is treated or coated so it can be used without needing carbon coating or interleaved carbon paper.

CARLOAD. Quantity of paper shipped from mill in one freight car. Must exceed a freight classification zone minimum weight to qualify for carload freight rate.

CAST-COATED PAPER. Very high-gloss coated paper and paperboard with surface characteristics produced by allowing applied coating to harden while in contact with surface of steam-heated, highly polished, chrome-plated drum.

CELLULOSE. Chief substance in cell walls of plants used to manufacture pulp.

CELLULOSE WADDING. See *wadding.*

CHEMICAL PULP. Mass of fibers resulting from reduction of wood or other fibrous raw material into component parts during cooking phases with various chemical liquors in processes such as sulfate, sulfite, soda, and NSCC.

CHEMI-THERMOMECHANICAL PULP (CTMP). Pulp made by thermomechanical process in which woodchips are pretreated with a chemical, usually sodium sulfite, either prior to or during presteaming as an aid to subsequent mechanical processing in refiners.

CHIPBOARD. Inferior-quality, low-density, solid or lined paperboard made primarily from recycled wastepaper stock and used in low-strength applications.

CLARIFIERS. Storage tanks in which suspended solids are allowed to settle and be removed from green and white liquors in the causticizing areas of a pulp mill.

COATED. Papers and paperboards that contain a layer of coating material, such as clay or pigment, in combination with an adhesive.

COMBINATION BOARD. Multi-layered, cylinder-made paperboard having outer and inner layers made from different pulpstocks.

COMBINED BOARD. Multi-layered board made by uniting a number of boards with proper adhesives.

CONSTRUCTION PAPER. Heavy type of paper used for watercolor and crayon artwork, made in various colors primarily from groundwood pulp.

CONTAINERBOARD. Single- and multi-ply, solid, and corrugated boards used to make boxes and other containers for shipping materials.

COOK. Process of reacting fiber-containing materials, such as wood, rag, straw, and bagasse, with suitable chemicals, usually under high temperature and pressure, in order to reduce them into component parts so that acceptable fibers can be separated and made into pulp.

CORD. Pulpwood volume measurement indicating a pile measuring 4 ft x 4 ft x 8 ft, equaling 128 ft^3 (3.62 m^3).

CORRUGATED BOARD. (1) A pasted, single- or double-faced, multilayered board having a fluted bottom or middle layer. (2) The fluted paperboard after it has gone through the corrugating operation and before it is pasted to the flat facing board sheet.

CORRUGATING MEDIUM. Paperboard made from chemical and semichemical pulps, sometimes mixed with straw or recycled paperstock, that is to be converted to a corrugated board by passing it through a corrugating machine.

COVER PAPER. Paper used as a protective covering for books, pamphlets, magazines, catalogs, and boxes.

CREPE PAPER. Low-basis-weight paper made from sulfite, sulfate, or mechanical pulp and given a simulated crinkly finish by crowding the web sheet over a roll with a doctor blade.

CROSS DIRECTION (CD). Side-to-side direction of a paper machine or the paper sheet made on it, as opposed to *machine direction,* which runs from head to exit end.

CUNIT. Pulpwood measurement equivalent to a volume containing 100 ft^3 solid of unpeeled wood.

CURL. Paper or paperboard deformation caused by nonuniform distribution of strains and stresses throughout the sheet as a result of uneven internal moisture and conditioning.

CUT SIZE. Fine paper cut to specific end-use dimensions (16 in. x 21 in. or less) on a paper trimmer usually of the guillotine or rotary type.

CYLINDER MACHINE. Machine primarily used to make paperboards. The forming cylinders are covered with wire so that, as they turn within a vat filled with stock solution, fibers are picked up to form a web on the surface with water draining through and passing out at the ends. The wet sheet is then transferred off the cylinder onto a felt for possible combining with other sheets (multiple cylinders on same machine) and subsequent pressing and drying.

D

DEINKING. Removal of ink and other undesirable materials from wastepaper by mechanical disintegration, chemical treatment, washing, and bleaching before reusing as a source of papermaking fiber.

DIE CUT. Paper and paperboard products cut by a metallic die to specified dimensions or form.

DIGESTER. Pressure vessel used to chemically treat chips and other cellulosic fibrous materials such as straw, bagasse, rags, etc., under elevated temperature and pressure in order to separate fibers and produce pulp.

DIMENSIONAL STABILITY. Ability of a sheet to maintain its original machine and cross-machine dimensions with time and under variable moisture and relative-humidity conditions.

DRY END. Portion of a paper machine where sheet moisture is removed by evaporation. Consists of several dryer sections or air dryers, depending on type and size of the machine.

DRYERS. Portion of a paper machine where water is removed from wet paper by passing it over rotating, steam-heated, cylindrical, metal drums or by running it through a hot air stream.

DUPLEX. (1) Papers and paperboards with each side having a different color, finish, or surface texture, which is produced on the paper machine or by pasting. (2) General term referring to multi-ply paper and paperboard and to bags made of two separate sheets of paper.

E

ELECTROSTATIC COPY PAPER. Smooth-finished, stable, medium-weight bond paper made from chemical pulps. Generally treated with a zinc oxide coating material and used on dry-type office copying machines.

ELMENDORF TEST. Test commonly used in paper mill laboratories to determine tear-resistant property of paper. Also called *tear test.*

ELONGATION. Physical property of a paper sheet that allows it to experience a certain degree of stretching.

EMBOSSED. Paper finish obtained by mechanically impressing a design on the sheet with engraved metallic rolls or plates.

ENAMEL. Clay coating on coated paper.

ENGLISH FINISH. Medium finish applied to a sheet of paper that is smoother than the finish coming off dryers or calenders, but not as smooth as the finish coming off supercalenders.

F

FABRIC PRESS. Paper machine wet press that uses a special multiple-weave fabric belt sandwiched between the regular felt and the rubber-covered roll, increasing the capacity to receive and remove water from the nip between rolls.

FEEL. Evaluation of paper surface finish by sense of touch.

FELT. Woven belt of wool, cotton, or synthetic fibers used to transport sheet of paper between rolls of press section (wet felt) and against dryer drum (dryer felt) in dry-end section of paper machine.

FELT SIDE. Top side of paper sheet as it is formed on wire of wet end of paper machine, which later comes in contact with felts during subsequent drying phases.

FIBER. Elongated, tapering, thick-walled cellular unit that is the structural component of woody plants.

FILLER. (1) Substance added to pulpstock to fill spaces between fibers and enhance printing properties of paper made from it. (2) Inner layers of multi-ply paperboards.

FINE PAPERS. High-quality printing/writing and cover papers having excellent surface characteristics for pen and ink writing.

FINISH. Surface characteristics of sheet of paper, such as smoothness, appearance, and gloss, as determined visually.

FINISHING. Processing of paper after completion of papermaking operations, including supercalendering, slitting, rewinding, trimming, sorting, counting, and packaging prior to shipment from mill.

FLEXOGRAPHIC PRINTING. Rotary letterpress printing process using ink made of aniline dyes and pigments (mixed with a binder) that dries primarily by evaporation due to the solvent vehicle (with rapid evaporation properties) used. Also called *aniline printing.*

FLUFF PULP. Thick sheet or batt of woodpulp fibers manufactured in roll or bale form and suitable for dry disintegration into individual fibers.

FLUORESCENT PAPER. White paper made with synthetic dyes that produce a brighter appearance by increasing the ability to reflect light, or paper that is surface-coated with colored, light-emitting dyestuff materials (which reflect white light as a color).

FORMATION. Physical distribution and orientation of fibers and other solid constituents in the structure of a sheet of paper that affects its appearance and other physical properties.

FOURDRINIER WIRE. Continuously traveling, endless, woven, metallic, or plastic screen belt located in wet-end section of fourdrinier paper machine. Pulpstock is fed onto wire so that water is drained from it as fibers become oriented to form a continuous web.

FREENESS. Ability of pulp and water mixture to release or retain water on drainage.

FREE-SHEET. Sheet of paper containing no mechanical pulp fibers or made of pulp subjected to minimal refining or hydration, which allows water to drain quickly when sheet is formed on fourdrinier wire. Also called *woodfree.*

FURNISH. Various pulps, dyes, additives, and other chemicals blended together in stock preparation area of paper mill and fed to wet end of paper machine to make paper or paperboard. Also called *stock.*

G

GLASSINE. Light, dense, translucent paper made from highly refined chemical pulp and possessing a high degree of hydration. Used as envelope windows and in protective packaging for foodstuffs, candy, tobacco products, chemicals, and metallic items.

GLOSS. Property of paper sheet surface that produces a shiny, highly reflective appearance when light is reflected from it.

GRAIN. Directional alignment of fibers in a paper sheet structure.

GRAVURE PRINTING. Intaglio printing process employing minute engraved "wells." Generally, deeply etched wells carry more ink than a raised surface; hence, they print darker values. Shallow wells are used to print light values. A doctor blade wipes excess ink from the cylindrical printing surface. Rotogravure employs etched cylinders and web-fed stock. Sheet-fed gravure, as its name implies, involves individual sheet feeding.

GROUNDWOOD PAPER. Paper that is made from a furnish containing a large percentage of groundwood pulp.

GROUNDWOOD PULP. Slurry produced by mechanically abrading fibers from barked logs through forced contact with the surface of a revolving grindstone. Used extensively to make newsprint and publication papers.

H-K

HARD-SIZED. Paper and paperboard made resistant to water and ink penetration by exposure to high degree of sizing treatments.

HARDWOOD. Pulpwood from broad-leaved dicotyledonous deciduous trees.

HEMICELLULOSE. Alkali-soluble, noncellulosic polysaccharide portion of a wood cell wall.

HOLDOUT. Ability of paper or board to resist surface liquid penetration.

HOTMELTS. Plastic or wax coating materials in a molten state applied to paper or paperboard sheet to produce fluid-resistant surface with high gloss.

INDUSTRIAL PAPERS. Paper made for purposes such as industrial packaging, tissues, wrappings, impregnating, insulating, etc.

INTEGRATED MILL. Mill manufacturing complex in which all pulp and papermaking operations are conducted at one site.

INTERNAL BONDING STRENGTH. See *bonding strength.*

JOB LOT. Out-of-specification, defective, or discontinued types of paper made in small quantities for special orders and sometimes sold at lower-than-standard prices.

JUMBO ROLL. (1) Larger-than-normal roll of paper as it is slit and rewound. (2) Roll of paper usually greater than 12 in. in diameter and used for converting into user products.

KRAFT PAPER. High-strength paper made from sulfate pulp, usually with a naturally brown color from unbleached pulp. Also called *sulfate paper.*

KRAFT PULP. Fibrous material used in pulp, paper, and paperboard manufacturing, produced by chemically reducing woodchips into their component parts by cooking in a vessel under pressure using an alkaline cooking liquor. Also called *sulfate pulp.*

L

LACQUER. Organic solution with volatile solvents used for coating paper to give high surface gloss, grease resistance, heat sealing, and improved surface appearance.

LAMINATED PAPER. Multi-ply paper and paperboard consisting of firmly united, superposed layers, which may be bonded with resin or adhesive.

LEDGER PAPER. Strong, highly sized paper made from bleached chemical woodpulp. Used to make accounting and record books; also used with accounting machines.

LETTERPRESS PRINTING. Printing process in which ink is applied to paper, paperboard, or film from raised portions of printing plates or type.

LIGNIN. Brown organic substance that acts as an interfiber bond in woody materials.

LINERBOARD. Kraft paperboard, generally unbleached, used to line or face corrugated core board (on both sides) to form shipping boxes and various other containers.

M

MACHINE-COATED. Paper and paperboard that have surface coating of adhesives and minerals applied while being made on the paper machine, as an integral part of the papermaking operation.

MACHINE-DIRECTION (MD). Direction from the wet end to the dry end of a paper machine or to a paper sheet parallel to its forward movement on a paper machine.

MACHINE-FINISH (MF). Surface finish produced on an uncoated sheet of paper as it is being made on the paper machine, and usually accomplished with limited calendering on the machine calender stacks.

MACHINE-GLAZED (MG). High-gloss surface finish produced on the wire side of a sheet by passing it over a large-diameter, highly polished, steam-heated roll as used on yankee-type paper machine dryers.

MANIFOLD PAPER. Very thin regular bond paper with glazed or unglazed finish used to make carbon copies of letters.

MATTE. Paper and surface finishes with very low gloss or luster.

MECHANICAL PULP. Pulp produced by reducing pulpwood logs and chips into their fiber components by the use of mechanical energy, via grinding stones, refiners, etc.

MEDIUM. See *corrugating medium.*

MOISTURE CONTENT (MC). Percent of water by its weight in paper, pulp, paperboard, chips, etc., which will vary according to atmospheric conditions because of the ability of these types of materials to absorb or emit moisture.

MOISTUREPROOF. Ability of paper and paperboard to resist the penetration of water vapor.

MOISTURE VAPOR TRANSMISSION. Ease or rate of water vapor permeation in a sheet of paper.

MOTTLE. (1) Random nonuniformity in printed gloss, or the visual density or color of a printed area caused by uneven absorption of ink by paper. (2) A surface effect produced by the addition of heavily dyed fibers of a different color in the stock furnish.

MULLEN. See *bursting strength.*

MULTI-PLY. Paper or paperboard sheet made up of two or more layers.

N-O

NEWSPRINT. Grade of paper, combining high percentages of groundwood pulp, made especially for use in the printing of newspapers.

NINEPOINT. Paperboards with a thickness of 9 mils (0.009 in.) used as the fluted component in the manufacture of multi-ply combined board or wrapping. See *corrugating medium.*

NONWOVEN FABRIC. Sheet of cloth-like material made from long natural and synthetic fibers and formed from a slurry on a wire screen, such as a wet end of a paper machine, or by laying on a fine mesh screen from an air suspension.

OFF-MACHINE COATING. Process of applying coating material to a sheet of paper or paperboard in a location that is away from the machine on which it is made.

OFFSET PRINTING. Process of indirect printing in which an impression of type or a design on a flat plate is printed on a rubber-blanketed cylinder from which it is impressed ("off-set") upon the surface to be printed.

ONIONSKIN. A thin, lightweight, transparent paper made especially for producing typewritten copies of correspondence.

OPACITY. Ability of substances such as paper, flue gases (smoke), and liquids to resist transmission of both diffuse and nondiffuse light through them. Prevents show-through of dark printing in contact with backside of sheet of paper.

OVEN-DRY (o.d.). Moisture-free conditions of pulp and paper. Usually determined by drying a known sample to a constant weight in a completely dry atmosphere at a temperature of 100°C to 105°C (212°F to 221°F). Also called *bone dry.*

P

PAPER. Homogeneous sheet of felted cellulose fibers, bound together by interweaving and by the use of bonding agents, and made in a variety of types.

PAPERSTOCK. Water slurry of various pulp fibers, dyes, additives, and chemicals that is pumped to the paper machine for forming into a sheet.

PAPETERIE. Chemical pulp and cotton-fiber content paper, made especially for conversion to a class of writing types, usually correspondence stationery.

PATENT COATED. Type of paperboard that is made and lined with white or colored fibers on a multi-cylinder machine, possessing a high surface finish suitable for use in making cartons.

PICK. (1) Phenomenon of pulp or fibers pulling away and sticking to paper machine parts, such as rolls, in the wet and dry end sections. (2) Paper mill control test to determine surface adhesion properties of paper. (3) Small particles of paper that loosen from the surface of paper, especially during printing.

PIGMENT. An insoluble mineral or organic powder used as a dye to color paper and as an additive to impart specific properties—bulk, porosity, opacity—to the sheet.

PLY. Layer that makes up a multi-layered, pasted, or multi-cylinder-formed paperboard.

POINT. Measurement of thickness of a sheet of paper or board (0.001 in.).

POROSITY. Ability of fluids to pass through paper and paperboard, related to size, shape, and distribution orientation of the pores in a sheet and the compactness of the fibers.

PRESSURE-SENSITIVE PAPER. Good-strength paper coated with a pressure-sensitive type of adhesive and converted to tapes and labels.

PRINTABILITY. Ease with which paper can be printed to high-quality standards with the least amount of spoilage.

PULP. Fibrous material produced by mechanically or chemically reducing woody plants into their component parts from which pulp, paper, and paperboard sheets are formed after proper slushing and treatment. Also used for dissolving purposes (dissolving pulp or chemical cellulose) to make rayon, plastics, and other synthetic products. Also called *woodpulp*.

R

RAG CONTENT. Paper containing from 25% to 75% cotton or rag fibers, including bond, ledger, and specialty papers.

REAM. Stack or package of paper containing a number of sheets (usually 480, 500, or 1,000) designated as standard for that grade.

REFINER MECHANICAL PULP (RMP). Pulp made by processing untreated woodchips in mechanical atmospheric refiners.

REFINING. Pulp and paper mill operations conducted of fiber suspensions to rub, brush, crush, fray, or cut fibers as desired. Imparts such characteristics as increased capacity to absorb water and improved sheet formation.

REGISTER PAPER. Lightweight writing grade made from chemical pulp and possessing good tensile and tearing strength. Comes in rolls especially for automatic register machines and in flat, folded, snap-apart packages for computer printouts and other copying purposes.

RELATIVE HUMIDITY. Actual amount of water vapor present in the air as compared with the maximum amount of water vapor the air could hold at that temperature.

RELEASE PAPER. Type of paper made especially for easily removal from sticky surfaces.

ROSIN. Material made up of a suspension and used for internal sizing of paper and paperboard.

ROTOGRAVURE PRINTING. See *gravure printing*.

RUNABILITY. (1) In the paper mill, how well pulp stock furnish to the paper machine forms a sheet on the wire and passes through the drying and finishing operations. (2) Used by customers in reference to how well the paper performs in their converting operations, such as on printing presses.

S

SCREENINGS. Rejected materials, such as knots, shives, and large bark particles, from the screening operations of pulp suspensions in a pulp mill.

SECONDARY FIBER. Any type of paper- and paperboard-making fiber obtained from wastepapers and other used, reclaimable fiber sources.

SEMICHEMICAL PULP. Lower-quality pulp made by cooking fibrous materials in a neutral sodium sulfite/sodium carbonate cooking liquor followed by a final separation of the fiber using unpressurized mechanical means.

SHEET. Flat piece of any type of pulp, paper, and paperboard having a variety of characteristics, sizes, and finishes.

SILVICHEMICALS. Chemical byproducts of the woodpulping process and other chemicals derived from wood.

SIZE. Substance such as rosin, gelatins, glues, starch, or waxes added to paperstock furnish or to the surface of a sheet in order to give water-resistant properties.

SIZE PRESS. Paper mill processing unit consisting of two usually rubber-covered rolls located between two dry end sections of the paper machine. Applies size solution to the surface of the paper sheet.

SLURRY. Liquid mixture consisting of suspended fibers, fillers, coating pigments, and other solid material in water or adhesive, used in the papermaking process.

SLUSH. Pulp stockwater suspension thin enough to flow or to pump through a pipeline, usually running about 1% to 6% consistency.

SODA PULP. Pulp made by the cooking of woodchips from deciduous or broadleaf trees in a sodium hydroxide or caustic soda solution.

SOFTWOOD. Wood obtained from evergreen, cone-bearing species of trees, such as pines, spruces, hemlocks, etc., which are characterized by having needles.

SOLID BOARD. Single-ply, homogeneous types of paperboards, made from the same stock throughout the sheet structure.

SPENT LIQUOR. Used cooking liquor in a chemical pulp mill that is separated from the pulp after the cooking process. Contains lignins, resins, carbohydrates, and other substances extracted from the material being cooked.

SPLICE. Joint made in a continuous sheet of paper with glue or adhesive tape when a break occurs in the web during winding or rewinding into a roll.

STANDARD CONDITIONS. Unless otherwise specified, assumed to be 29.92 in. of mercury and 70°F.

STARCH. Type of papermaking adhesive and sizing material made primarily from corn and potatoes. Produces a higher degree of rigidity in a sheet and improves the finish by causing the fibers to lie flat.

STIFFNESS. The ability of paper or paperboard to withstand bending or crushing forces.

STOCK. (1) Fibrous mixture that is made into paper. May consist of one or more types of beaten or refined pulps, with or without suitable fillers, dyes, additives, and other chemicals. Also called *furnish*. (2) Paper suitable for a particular use, such as coating raw stock, milk bottle stock, tag stock, etc.

SULFATE PROCESS. An alkaline pulp manufacturing process in which the active components of the liquor used to cook chips in a pressurized vessel are primarily sodium sulfide and sodium hydroxide, with sodium sulfate and lime being used to replenish these chemicals in recovery operations. Also called *kraft process.*

SULFITE PROCESS. An acid pulp manufacturing process in which chips are reduced to their component parts by cooking in a pressurized vessel using a liquor composed of calcium, sodium magnesium, or ammonia salts of sulfurous acid.

SUPERCALENDER. Auxiliary piece of papermaking equipment used on some paper machines to obtain a denser paper with a higher finish than paper obtained on a calender.

SURFACE-COATED. Any paper or paperboard sheet that has a coating material applied to one or both surfaces.

SURFACE-SIZED. Paper whose surface is treated with a sizing material after the sheet is formed on a paper machine, or in a separate, off-machine operation, occasionally after it has been internally sized.

SYNTHETIC FIBERS. Short filaments that are extruded or spun from synthetic resin materials and used in the manufacture of synthetic paper.

T

TACK. Sticky property of paper and paperboard adhesive and glue-coating materials.

TALL OIL. Byproduct made from the resins, fatty acids, and soap removed during the evaporation of sulfate black liquor.

TARNISHPROOF PAPER. See *antitarnish paper*.

TEAR STRENGTH. Resistance of a paper sheet to tearing, usually measured by the force required to tear a strip under standardized conditions.

TENSILE STRENGTH. Resistant property of a sheet to pull or stress produced by tension. Expressed as the force per unit width of a sample that is tested to the point of rupture.

TEST LINERBOARD. Types of paperboard that meet specific tests (Rule 41) adopted by the packaging industry to qualify for use as the outer facing layer for corrugated board, from which shipping containers are made.

TEXT PAPER. Good-quality, laid or woven book paper with a medium vellum-like finish.

THERMOMECHANICAL PULP (TMP). Pulp made by presteaming chips and reducing them into their fiber components during an initial mechanical treatment in refiners under elevated temperature and pressure. Subsequent refining done at atmospheric pressure.

TRANSPARENCY. Ability of paper to allow light rays to pass through it in such a manner that objects behind it can be clearly seen.

TRIM. Dimension of the widest sheet of paper that can be made on a paper machine, not including the edges (which are normally cut off).

TWIN-WIRE FORMER. Type of multi-ply paperboard machine having two wires (or fabrics) between which the sheet is formed.

TWO-SIDEDNESS. Visual difference between the top or felt side of a sheet of paper and the bottom or wire side.

V-Y

VEGETABLE PARCHMENT. Hard, dense sheet of grease-resistant paper, having a very high wet-strength property.

VELLUM FINISH. Smooth, dull finish applied to book and stationery paper surfaces to simulate sheets originally made from young calves' skin.

WADDING. Single- or multi-ply, loosely matted fiber sheet made from chemical pulp and used in packaging, thermal, and acoustical applications, and as a cushioning medium. Also called cellulose wadding.

WASTEPAPER. All types of used paper that provide a source of fiber for the manufacture of some papers, paperboards, and chipboards.

WEB. Continuous sheet of paper produced and rolled up at full width on the paper machine.

WET END. Section of the head end of a paper machine, which includes the headbox, wire, and wet press sections. Where the sheet is formed from the stock furnish and where most of the water is removed before entering the dryer section. Also called *wire end.*

WET MACHINE. Paper machine consisting essentially of a wire-covered cylinder rotating in a vat of pulpstock on which a mat of varying thicknesses is formed by drainage. These mats are removed either intermittently in thick sheets called laps, or continuously.

WET-STRENGTH PAPER. Paper in which the fiber constituents and/or the sheet are chemically treated to enhance resistance to tear, rupture, or disintegration after becoming saturated with liquids.

WET TENSILE STRENGTH. Resistance of a paper sheet to pull or stress produced by applied tension after it has become saturated with liquids.

WHITE PAPER. (1) Any paper made from pulpstock whose natural color has been corrected by the addition of blue, yellow, and red dyestuff. (2) To a printer, any paper sheet that is devoid of printing material.

WIRE. See *fourdrinier wire.*

WIRE MARKS. Small impressions produced on the bottom surface of a sheet of paper, caused by the mesh of the wire screen on which the wet web is formed in the wet end of a paper machine.

WIRE SIDE. Bottom side of a sheet of paper that comes in contact with the wire as the web is being formed in the wet end of a paper machine.

WOODFREE. See *free-sheet.*

YANKEE DRYER. Type of steam-heated paper dryer consisting of a large, revolving drum equipped with a felt to hold the sheet in contact with its highly polished surface. Commonly used for drying tissue-type papers.

METRIC CONVERSION GUIDE

Reproduced from *Metrication for the Pulp and Paper Industry* by Kenneth E. Lowe (Miller Freeman Publications, 1975).

CONVERSION LIST FOR NORTH AMERICAN AND METRIC UNITS

To convert	Into	Multiply by
acre	hectare	0.4047
Btu (mean)	joule	1.05587×10^3
centimeter	foot	0.03281
	inch	0.3937
cord	(see Forestry Terms)	
foot	centimeter	30.48
	meter	0.3048
gallon (U.S. liquid)	gallon (U.K.)	0.8327
	liter	3.785
gallon (U.K.)	gallon (U.S. liquid)	1.20094
	liter	4.545
horsepower (electric)	kilowatt	0.746
horsepower-hour	kilowatt-hour	0.7457
inch	centimeter	2.54
	meter	0.0254
joule	Btu	9.4845×10^{-4}
	calorie (mean)	0.23866
kilogram-mass	pound (avdp)	2.2046
	ton (metric)	0.001
	ton (short)	1.102×10^{-3}
kilometer	foot	3281
	mile (statute)	0.6214
kilowatt	horsepower (electric)	1.3405
kilowatt-hour	horsepower-hour	1.3410
liter	gallon (U.K.)	0.21998
	gallon (U.S. liquid)	0.2642
meter	foot	3.281
ounce (avdp)	gram	28.3495
	pound (avdp)	0.0625
pound (avdp)	kilogram	0.4536
pound/inch^2 (psi)	kilogram-force/cm^2	0.07031
square foot	square centimeter (cm^2)	929.0
	square meter (m^2)	0.09290
square meter	square foot (ft^2)	10.76
	square inch (in.^{2})	1550
ton (long)	ton (metric)	1.016
	ton (short)	1.120
ton (metric)	ton (long)	0.9842
	ton (short)	1.1023
ton (short)	ton (long)	0.89286
	ton (metric)	0.90718
yard	centimeter	9.144
	meter	0.9144

FACTORS FOR CONVERTING REAM AND BASIS WEIGHTS TO GRAMMAGE

Paper grade	Trade size 500-sheet ream (in.)[1]	Grammage (g/m^2) to ream or basis weight[1]	Ream weight[2] to grammage
Writing and printing	17 x 22	0.266	3.760
Demy size	17½ x 22½	0.280	3.571
Blotting	19 x 24	0.324	3.083
Cover	20 x 26	0.370	2.704
Tissue (double-crown size)	20 x 30	0.427	2.343
Cardboard	22 x 28	0.438	2.282
Bristol and tag	22½ x 28½	0.456	2.195
News and wrapping (3000 ft^2)	24 x 36	0.614	1.627
Book	25 x 38	0.675	1.480
Former standard size	25 x 40	0.711	1.406
Paperboard	1000 ft^2	0.205	4.881

Note: If the conversion factor for a sheet size is not listed, the ream weight or grammage can be calculated by the following formulas:

- Converting ream weight (lb/500 sheets) to grammage:

$$g/m^2 = \frac{\text{ream weight} \times 1406}{\text{sheet area in square inches}}$$

- Converting grammage to ream weight in lb/500 sheets:

$$\text{lb/ream} = g/m^2 \times \text{sheet area in square inches} \times 0.000711$$

1. If the given trade size is in 480 sheets, then factor should be multiplied by 48/50 (or 0.960).
2. If the given trade size is 480 sheets, then factor should be multiplied by 1.042.

Source: Based on TAPPI Standard T410.

COMPARISON OF ISO AND NORTH AMERICAN PAPER SIZES

ISO sizes			North American sizes		
	Millimeters	Inches		Millimeters	Inches
A0	841 x 1189	33⅛ x 46¾	NA0	889 x 1143	35 x 45
A1	594 x 841	23⅜ x 33⅛	NA1	559 x 864	22 x 34
A2	420 x 594	16½ x 23⅜	NA2	432 x 559	17 x 22
A3	297 x 420	11⅔ x 16½	NA3	279 x 432	11 x 17
A4	210 x 297	8¼ x 11¾	NA4	216 x 279	8½ x 11
A5	148 x 210	5⅞ x 8¼	NA5	139 x 216	5½ x 8½
A6	105 x 148	4⅛ x 5⅞	NA6	108 x 139	4¼ x 5½

METRIC UNITS FOR WIDELY USED TERMS IN FORESTRY

Term	North American symbol or definition	Suggested metric unit	Equivalent
LAND AREA			
Acre		hectare (ha)	1 acre = 0.4047 ha
Square mile	640 acres	hectare (ha)	1 mi^2 = 259.0 ha
		square kilometer (km^2)	1 mi^2 = 2.59 km^2
Section	640 acres	hectare (ha)	1 section = 259.0 ha
Township	36 square miles (mi^2)	hectare (ha)	1 township = 9324 ha
LUMBER AND BOARD MEASUREMENTS			
Board foot	bdf	cubic meter (m^3)	1 bdf = 0.002360 m^3
1000 board feet	1000 bdf	cubic meter (m^3)	1000 bdf = 2.360 m^3
Cubic foot	ft^3	cubic meter (m^3)	1 ft^3 = 0.02832 m^3
Square foot	ft^2	square meter (m^2)	1 ft^2 = 0.09290 m^2
Thickness	in.	millimeter (mm)	1 in. = 25.4 mm
WOOD AND PULPWOOD MEASUREMENTS			
Cord	128 ft^3	cubic meter (m^3)	1 cord = 3.624 m^3
Unit	160 ft^3 (wood)	cubic meter (m^3)	1 unit (160 ft^3) = 4.528 m^3
	200 ft^3 (chip)	cubic meter (m^3)	1 unit (200 ft^3) = 5.664 m^3
Cunit	100 ft^3 (solid)	cubic meter (m^3)	1 cunit = 2.832 m^3
Cubic foot	ft^3	cubic meter (m^3)	1 ft^3 = 0.02832 m^3
Yield/acre	ft^3/acre	cubic meter/hectare (m^3/ha)	1 ft^3/acre = 0.06998 m^3/ha

CONVERSIONS FOR ACCOUNTING

(continued next page)

Unit cost	Multiply by	To obtain
AREA		
\$/acre	2.47105	\$/hectare
\$/square foot	10.7639	\$/square meter
\$/1000 square feet	0.0107639	\$/square meter
	10.7639	\$/1000 square meters
\$/3000 square feet	0.0035879	\$/square meter
ELECTRICAL		
\$/kilowatt-hour	1.0	\$/kilowatt-hour
	0.277778	\$/megajoule
ENERGY		
\$/cubic foot (gas)	35.3147	\$/cubic meter
\$/1000 cubic feet (gas)	35.3147	\$/1000 cubic meters
\$/gallon (U.S.)	(see *Volume*)	
\$/gallon (U.K. liquid)	(see *Volume*)	
FREIGHT		
\$/ton (2000 lb)	(see *Weight*)	\$/metric ton
\$/ton-mile	0.6849	\$/metric ton-kilometer
LABOR		
ton (2000 lb)/man-day	0.9072	metric tons/man-day
\$/ton (2000 lb)	1.10231	\$/metric ton

CONVERSIONS FOR ACCOUNTING

(continued)

Unit cost	Multiply by	To obtain
VOLUME		
$/gallon (U.S.)	0.264173	$/liter
	264.173	$/cubic meter
$/gallon (U.K.)	0.219969	$/liter
	219.969	$/cubic meter
$/1000 gallons (U.S.)	0.264173	$/1000 liters
	0.264173	$/cubic meter
$/million gallons (U.S.)	0.264173	$/1000 cubic meters
$/cubic foot	35.3147	$/cubic meter
$/cubic yard	1.30795	$/cubic meter
WEIGHT (mass)		
$/pound	2.20462	$/kilogram
$/100 pound (CWT)	0.0220462	$/kilogram
$/short ton (2000 lb)	1.10231 (0.9072)	$/metric ton
$/long ton (2240 lb)	0.984206	$/metric ton
WOOD VOLUME		
$/board foot	423.76	$/cubic meter
$/1000 board feet	0.42376	$/cubic meter
$/cubic foot	35.3147	$/cubic meter
$/cord (128 ft^3)	0.2759	$/cubic meter
$/unit (wood)	0.2208	$/cubic meter
$/unit (chip)	0.1766	$/cubic meter
$/cunit (100 ft^3)	0.3531	$/cubic meter

For example, assume the selling price for 42-lb linerboard is $300/ton. Calculate the price per 1000 m^2:

$$\frac{300 \times 42.0}{2000} = \$6.30/1000\ \text{ft}^2\text{; thus}$$

$$6.30 \times 10.764 = \$67.81/1000\ \text{m}^2$$

Another formula for calculating price on a 1000-square-meter basis is:

$$\$/1000\ \text{m}^2 = (\$/\text{metric ton})\ (\text{grammage})\ (0.001)$$

For example, assume that the selling price of linerboard with a grammage of 205 g/m^2 is $400/metric ton. Calculate the price per 1000 m^2:

$$400 \times 205 \times 0.001 = \$82.00/1000\ \text{m}^2$$

SOURCES OF INDUSTRY INFORMATION

Advertisers & Publishers Service Inc.
300 N. Prospect Ave., Park Ridge, Ill. 60068
tel. (708)823-3145
- SOS/Sources of Supply Buyers Guide (annual)

Allen/Abernethy Publishing Div. of ASM Communications
75 Third St. N.W., Atlanta, Ga. 30365
tel. (404)841-3333
- American Papermaker (in four regional editions; monthly except bimonthly in October)

American Paper Institute
260 Madison Ave., New York, N.Y. 10016
tel. (212)340-0600
- Dictionary of Paper (4th edition, 1980)
- Exports of Kraft Linerboard and Corrugating Material (annual)
- Fiber Statistics Subscription Service
- International Report (intermittent)
- Paper, Paperboard, Wood Pulp Capacity (annual)
- Paper, Paperboard & Wood Pulp/Monthly Statistical Summary
- Paper Production Report (weekly)
- Statistics of Paper, Paperboard & Wood Pulp (annual)
- U.S. Exports of Pulp, Paper, Paperboard and Converted Products (annual)
- U.S. Exports of Wastepaper by Destination (annual)
- U.S. Woodpulp Data (monthly)
- Wood Pulp & Fiber Statistics (annual)

American Newspaper Publishers Assn.
Box 17407, Dulles International Airport
Washington, D.C. 20041
tel. (703)648-1000
- Presstime (monthly)

American Pulpwood Assn.
1619 Massachusetts Ave. N.W.
Washington, D.C. 20036
tel. (202)347-2900
- Monthly Pulpwood Summary

Arnold Services
106 Runcorn Road, Moore, Warrington WA4 6UB, U.K.
- Yeast from Spent Sulphite Liquor: Manufacture and Marketing

Assn. of Nonwoven Fabrics Industry
1700 Broadway, New York, N.Y. 10019
- International Directory of the Nonwoven Fabrics Industry (biennial)

Benn Publications Ltd.
Sovereign Way, Tonbridge, Kent TN9 1RW, U.K.
- Paper (semi-monthly)

Business Press Inc.
70 Oak St., Norwood, N.J. 07648
- Paper Age (monthly)

Business Trend Analysts
2171 Jericho Turnpike, Commack, N.Y. 11725
tel. (516)462-5454
- The Corrugated and Paperboard Container Industry: An Analysis of Current Markets and Prospects for Future Growth (1986)
- U.S. Market for Household Paper Products: A Strategic Marketing Analysis and Biennial Review

Canadian Paper Analyst (monthly)
Box 300, Victoria Station
Westmount, Que. H3Z 2V5, Canada
tel. (514)993-8749

Canadian Pulp & Paper Assn.
2300 Sun Life Bldg., 1155 Metcalfe St.
Montreal, Que. H3B 2X9, Canada
tel. (514)866-6621
- Canadian Market Pulp Statistics (monthly)
- Canadian Pulp and Paper Capacity (annual)
- Monthly Newsprint Statistics
- Newsprint Data (annual)
- Reference Tables (annual)
- Statistical Bulletin (monthly)

Central Assn. of Finnish Forest Industries
Eteläesplanadi 2, SF-00130 Helsinki, Finland
tel. (0)132-61
- Finnish Forest Industries, 1987

Communication Conseil International
96, rue Montmartre, 75002 Paris, France
- Papercast (monthly)

Data Resources
24 Hartwell Avenue, Lexington, Mass. 02173
tel. (617)863-5100
- Annual Survey of U.S. Businesses' Plans for New Plants and Equipment (McGraw-Hill Capital Spending Surveys)

Data-Transcripts
Box 14, Dorking, Surrey RH5 4YN, U.K.
- Kraftliner Price Movements vs Supply & Demand Shifts Since 1974
- Specialty Papers and Boards Worldwide Trends & Developments
- Specialty Papers and Products Record (monthly)
- Thermal & Dielectric Papers—Technology, Markets & Company Data

Euro-Data Analysts
Box 13, Dorking, Surrey RH5 4YL, U.K.
- Cost Effective Product Development & Marketing in Paper & Board Mills (1986)

European Paper Institute
42, rue Galilée, F- 75116 Paris, France
tel. (1) 47 204 383
- Paper Capacity Report (annual)

Fibre Box Assn.
5725 N. East River Road, Chicago, Ill. 60631
tel. (312) 364--9600
- Fibre Box Industry Annual Report
- Statistical Bulletin/Containerboard Shipments, Consumption, Inventory (monthly)

Food & Agriculture Organization, United Nations
Via della Terme di Caracalla, I- 00100 Rome, Italy
- Estimated Production of Pulp, Paper and Paperboard in Certain Countries (annual)
- Projected Pulp and Paper Mills in the World (annual)
- Pulp and Paper Capacities (annual)

Frost & Sullivan Inc.
106 Fulton St., New York, N.Y. 10038
tel. (212)233-1080
- Paper Chemicals (1987)

Grade Finders Inc.
Box 944, Exton, Pa. 19341
tel. (215)524-7070
- Competitive Grade Finder for the Paper and Graphic Arts Industry (annual)

Harcourt Brace Jovanovich Inc.
111 E. Wacker Dr., Chicago, Ill. 60601
- Official Board Markets (weekly)

Harcourt Brace Jovanovich Inc.
120 W. Second St., Duluth, Minn. 55802
- Paper Year Book (annual)
- Paper Sales (monthly)

Harcourt Brace Jovanovich Inc.
7500 Old Oak Blvd., Cleveland, Ohio 44130
tel. (216)243-8100
- Paperboard Packaging (monthly)

Hatton Brown Publishers
610 S. McDonough St., Montgomery, Ala. 36197
tel. (205)834-1170
- Paper Industry Equipment (bimonthly)

Hilary House Publishers Inc.
1033 Channel Dr., Hewlett Harbor, N.Y. 11557
- Printing and Graphic Arts Buyers (annual)

Indufor Ky
Kapteeninkatu 14, Box 121, SF-00141, Helsinki, Finland
- Future Prospects of the Soviet Pulp and Paper Industry

International Paper Co.
2 Manhattanville Road, Purchase, N.Y. 10577
tel. (914)397-1500
- Pocket Pal/Graphic Arts Production Handbook

Jaakko Pöyry Oy
Box 16, SF-00441 Helsinki, Finland
- Annual Review of Pulp and Paper Mill Projects Worldwide (annual)
- Monthly Report on Pulp and Paper Mill Projects in the World (11 issues/year)
- Short-term Review of International Pulp & Paper Markets, Worldwide (quarterly)

Japan Paper Assn.
Kami-Parapu Kaikan Bldg., 9-11 Ginza 3-chome
Chuo-ku, Tokyo, Japan
tel. 543-2411
- Pulp & Paper Statistics (annual)

Laves Chemie
Hamburger Allee 12, D-6000 Frankfurt 90, Fed. Rep. Germany
- Carbonless Copy Paper, 1980 through 1990 (5th edition)

Maclean-Hunter Ltd.
777 Bay St., Toronto, Ont. M5W 1A7, Canada
tel. (416)596-5000
- Pulp and Paper Journal (9 times/year and directory/desk calendar)

Maclean-Hunter Publishing Corp.
300 W. Adams St., Chicago, Ill. 60606
tel. (312)726-2802
- Boxboard Containers (monthly)
- Paper, Film & Foil Converter (monthly)

Marketing/Technology Service Inc.
4100 South Seventh St., Kalamazoo, Mich. 49009
tel. (616)375-1236
- North American Fluff Pulp Markets and Prospects for 1986-96

Market News Publishing Corp.
156 Fifth Ave., New York, N.Y. 10010
tel. (212)608-7100
- Fibre Market News (two times/week)

Merrill Lynch, Pierce, Fenner & Smith Inc.
Securities Research Div.
165 Broadway, New York, N.Y. 10080 tel. (212)637-7455
- Forest Products and Paper Industry (monthly)

Miller Freeman Publications
600 Harrison
San Francisco, Calif. 94107
tel. (415)905-2200
- International Glossary of Technical Terms for the Pulp and Paper Industry (1976)
- Lockwood-Post's Directory of the Pulp and Paper and Allied Trades (annual)
- Map of the European Pulp & Paper Industry (1984)
- Market Pulp Survey
- Mill-by-Mill Listings of Capital Spending Programs (semiannual)
- Company Profiles (annual report)
- Paper Recycler (monthly)
- PaperTree Letter (monthly)
- PPI/Capital Investment Service (update on order)
- PPI/International Fact & Price Book (biennial)
- PPI/International Pulp & Paper Directory (biennial)
- PPI/This Week (weekly—48 times/year)
- PPI/Top 150 Companies in the World (annually in September)
- PULP & PAPER (monthly except twice in November)
- PULP & PAPER Buyers Guide (annual)
- Pulp & Paper Dictionary By John R. Lavigne
- PULP & PAPER Forecaster (bimonthly)
- PULP & PAPER INTERNATIONAL (monthly)
- Pulp & Paper Mills in the U.S. & Canada (map, 1988)
- PULP & PAPER Project Report (monthly, with semiannual Mill-by-Mill Listings supplement)
- PULP & PAPER WEEK (weekly—48 times/year)
- Synthetic Polymers and the Paper Industry By Vladimir M. Wolpert

Morgan Stanley, Investment Research
1251 Ave. of the Americas, New York, N.Y. 10020
tel. (212)703-4000
- Paper Industry Monthly by Thomas P. Clephane and Jeanne Carroll

National Assn. of Recycling Industries Inc.
330 Madison Ave., New York, N.Y. 10017
- Monthly Paper Stock Statistics

National Forest Products Assn.
1250 Connecticut Ave. N.W., Suite 200
Washington, D.C. 20036
tel. (202) 463-2700
- International Trade Report (monthly)

National Paper Trade Assn.
111 Great Neck Road, Great Neck, N.Y. 11021
tel. (516)829-3070
- Paper Merchant Performance (annual)
- Paper Merchant Sales Report (monthly)
- The Paper Distribution Industry (annual)
- Who's Who in Paper Distribution (annual)

OECD/Organization for Economic Cooperation and Development, Paris, France
OECD Publications Center
tel. (202)785-6323
1750 Pennsylvania Ave. N.W., Washington, D.C. 20006
- Pulp and Paper/Quarterly Statistics (quarterly)

Pacific Northwest Forest & Range Experiment Station, Forest Service, U.S. Dept. of Agriculture
809 N.E. 6th Ave., Portland, Ore. 97232
tel. (503)326-2877
- Production, Prices, Employment & Trade in Northwest Forest Industries (quarterly)

PAPIS Ltd.
Collingham House, Gladstone Road
Wimbledon, London SW19 1QH, U.K.
- Pulp Buyers Survey

Pima (Paper Industry Management Assn.)
2400 E. Oakton St., Arlington Heights, Ill. 60005
tel. (708)956-0250
- Pima (monthly)
- Pima Pulp & Paper Mill Catalog (annual)

Resource Information Systems Inc.
110 Great Road, Bedford, Mass. 01730
tel. (617)271-0030
- Paper Packaging Monitor (monthly)
- Paper Trader (monthly)
- World Pulp Monthly

Southam Business Publications
310 Victoria Ave., Westmount, Que. H3Z 2M9, Canada
tel. (514)339-1399
- Pulp & Paper Canada (monthly)
- Pulp & Paper Canada Annual and Directory (annual)

Statistics Canada
Publications Distribution, User Services Div.
Ottawa, Ont. K1A 0T6, Canada
tel. (613)951-8116
- Canada: Exports by Commodities and Countries (Catalog 65-004—includes pulp and paper grades; monthly)
- Canada: Imports by Commodities and Countries (Catalog 65-007—includes pulp and paper grades; monthly)
- Pulp and Paper Mills (Catalog No. 36-204—annual)
- Pulpwood and Wood Residue Statistics (Catalog No. 25-001—monthly)

Superintendent of Documents
U.S. Government Printing Office
Washington, D.C. 20402
tel. (202)783-3238
- U.S. Imports, Schedule A, Commodity by Country (Catalog FT135—includes pulp & paper grades; monthly)
- U.S. Exports, Schedule E, Commodity by Country (Catalog FT410—includes pulp & paper grades; monthly)
- 1987 Census of Manufactures

Pulp Mills (SIC 2611)
Paper Mills (SIC 2621)
Paperboard Mills (SIC 2631)
- Current Industrial Reports: Pulp, Paper & Board—M26A (annual)
- U.S. Industrial Outlook

Swedish Pulp and Paper Assn.
Villagatan 1, S-114 32 Stockholm, Sweden
- SCPF Annual Report

TAPPI (Technical Assn. of Pulp & Paper Industry)
15 Technology Park South, Norcross, Ga. 30092
tel. (404)446-1400
- Tappi Journal (monthly)
- Tappi Journal Directory (annual)

Timber Mart—South Inc.
Box 1278, Highlands, N.C. 28741
tel. (704)526-3653
- Timber Mart—South (monthly)

University of Wisconsin
432 North Lake St., Madison, Wis. 53706
tel. (608)262-1234
- Wisconsin Forest Products Price Review (three segments, quarterly or semi-annually)

Walden-Mott Corp.
475 Kinderkamack Road, Oradell, N.J. 07649
tel. (201)261-2630
- Walden's ABC Guide and Paper Production Yearbook (annual)
- Walden's Fiber & Board Report (semimonthly)
- Walden's Handbook/For Paper Salespeople and Buyers
- Walden's Paper Catalog (2 times a year, in 6 regional editions)
- Walden's Paper Report (twice monthly)

Wood Fibre Northwest (quarterly)
Box 572, Albany, Ore. 97321
tel. (503)928-4576

COMPANY PROFILES

This section is a listing of U.S. and Canadian companies with daily production capacity of at least 1,000 short tons (U.S.) or 900 metric tpd (Canada), counting facilities for pulp, paper, and paperboard.

Operations are listed under the name of the corporate owner, except when the owner is not in the pulp/paper/board industry. Subsidiaries and joint ventures in the U.S. and Canada are included under the parent firm. Foreign operations are not listed.

Sales and earning figures (when available) are given for 1986 to 1990, and a brief description of each company follows. Pulp and paper/board production sites—with capacity and grades—are also listed. All pulp produced at a millsite, whether shipped as market pulp or consumed onsite in papermaking, is counted.

Financial data:	All sales and earnings figures are shown in U.S. dollars, unless indicated "C$" for Canadian dollars.
Production data:	All capacity production data are set in short tons of 2,000 lb, unless specifically indicated as metric. To convert to metric tons—multiply by 0.90718. To convert to short tons—multiply by 1.1023.

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Abitibi-Price Inc.

207 Queens Quay West
Suite 680, P.O. Box 102
Toronto, Ont. M5J 2P5
Bernd K. Koken, chairman; Ron Y. Oberlander, chief executive officer

(Olympia & York Developments Ltd. owns roughly 82% of Abitibi-Price.)

(million C$)

	Net sales	Net earnings
1990	C$3,088.0	C$-44.6
1989	3,257.7	54.2
1988	3,304.5	191.1
1987	2,988.0	125.7
1986	2,763.5	107.3

Abitibi-Price is one of the world's largest producers of both newsprint and uncoated groundwood papers, with an annual North American capacity, on an equity basis, of more than 2 million metric tons. The company intends to transform into a low-cost, world-class producer. About 90% of total sales result from pulp, paper, paperboard, converting, and distribution operations.

Abitibi-Price's core business is newsprint and groundwood papers. At the end of 1990, Abitibi's newsprint capacity represented over 10% of North American capacity and about 6% of world capacity. However, this position is shrinking in the current market downturn, as the company has agreed in principal to sell its Pine Falls, Man., newsprint mill, and the currently idle Thunder Bay Div. newsprint mill could face permanent closure.

In August 1991, Abitibi sold its Innova Envelope unit to Supremex Inc for about C$73 million.

Sales of printing papers in 1990 were as follows: newsprint, C$998 million; groundwood papers, C$344 million; coated papers, C$130 million. Distribution sales were C$1,365 million.

Newsprint capacity (including affiliates) in 1990, was 2,152,800 metric tons; groundwood papers, 488,000 tons; and coated papers, 192,800 tons. Production (including affiliates) of newsprint in 1990 was 1.723 million tons; groundwood papers, 420,000 tons; and coated paper, 126,000 tons. Capital expenditures were C$260 million in 1989 and fell to C$107 million in 1990. In 1991, Abitibi budgeted just C$60 million for capital spending, less than 2% of projected sales.

Alabama River Newsprint, a US$320-million joint venture with Parsons & Whittemore Inc., came online in 1990. It will soon be outfitted with a deinking plant, enabling the 220,000-metric-tpy mill to manufacture 40% recycled-content newsprint. This follows a late-1990 conversion of part of its newsprint mill in Augusta, Ga., to recycled fiber, in which a 100,000-tpy deinking facility was added.

Abitibi has shelved plans to install a $50-million, 55,000-tpy deinking facility at Fort William, Que., by second-quarter 1992. At the Grand Falls, Nfld., mill, one of the three newsprint machines was shut down. In addition, a fine papers coating plant in Georgetown, Ont., was closed in February 1991 after two consecutive years of losses.

Abitibi owns 792,994 acres of timberland and controls another 11.8 million productive acres.

Production facilities:

PINE FALLS, MAN. (sale pending)
Pulp—135 metric tpd sulfite; 360 metric tpd groundwood
Newsprint—487 metric tpd

GRAND FALLS, NFLD.
Pulp—250 metric tpd sulfite; 530 metric tpd thermomechanical
Newsprint—680 metric tpd

STEPHENVILLE, NFLD.
(Stephenville Div.)
Pulp—426 metric tpd thermomechanical
Newsprint—470 metric tpd

IROQUOIS FALLS, ONT.
Pulp—215 metric tpd sulfite; 640 tpd groundwood
Newsprint—814 metric tpd

THUNDER BAY, ONT.
(Provincial Papers)
Pulp—150 metric tpd groundwood
Printing/writing papers—466 metric tpd

THUNDER BAY, ONT.
(Fort William Div.)
Pulp—150 metric tpd sulfite (SCMP); 300 tpd groundwood
Newsprint—393 metric tpd

THUNDER BAY, ONT.
(Thunder Bay Div.)
(shut down 4/91 for at least two years)
Pulp—140 metric tpd sulfite; 420 tpd groundwood
Newsprint—500 metric tpd

ALMA, QUE.
Pulp—125 metric tpd sulfite; 472 tpd groundwood
Newsprint—366 metric tpd
Uncoated groundwood—260 metric tpd

BEAUPRÉ, QUE.
Pulp—600 metric tpd thermo-chemical mechanical pulp
Uncoated groundwood—410 metric tpd

CHANDLER, QUE.
(Gaspesia Pulp & Paper Co.—Abitibi owns 51%; New York Times Co., 49%)
Pulp—495 metric tpd groundwood; 60 tpd refiner mechanical; 225 tpd bisulfite chemimechanical
Newsprint—694 metric tpd

JONQUIERE, QUE.
Pulp—306 metric tpd groundwood; 320 tpd thermo-chemical mechanical pulp (TCMP); 275 tpd sulphite
Uncoated groundwood—630 tpd

LaCHUTE, QUE.
(Price Wilson)
Packaging, toweling paper—50 metric tpd

CLAIBORNE, ALA.
(Alabama River Newsprint—joint venture with Parsons & Whittemore)
Newsprint—526 metric tpd

AUGUSTA, GA.
(Augusta Newsprint Co.—joint venture with Thomson Corp.)
Pulp—450 groundwood; 750 tpd thermomechanical
Newsprint—1,124 metric tpd

Total production capacity:
(Not including Thunder Bay Div.)

PULP	
Groundwood	3,173 metric tpd
BCMP	225 metric tpd
Refiner mechanical	60 metric tpd
Sulfite	1,150 metric tpd
TCMP	920 metric tpd
TMP	1,706 metric tpd
Total	7,794 metric tpd
PAPER	
Newsprint	5,554 metric tpd
Groundwood	1,300 metric tpd
Printing/writing	466 metric tpd
Packaging/toweling	50 metric tpd
Total	7,370 metric tpd

Appleton Papers Inc.

825 E. Wisconsin Ave.
P.O. Box 359
Appleton, Wis. 54912
Gordon Bond, chief executive officer

(Appleton Papers Inc. and Wiggins Teape Group were combined under a publicly held holding company run by management from the two firms. The new company is now called Wiggins Teape Appleton plc, and its spinoff from B.A.T Industries plc began trading on the London Stock Exchange June 1, 1990. B.A.T was forced to divest itself of some properties during its fight against a hostile takeover bid.)

(million $)

	Net sales	Operating income
1990	$943.0	$163.0
1989	911.0	151.0
1988	844.0	131.0
1987	779.3	126.3
1986	723.2	134.3

Appleton is the world's leading producer of carbonless copy paper and holds roughly 50% of the U.S. market. It also produces thermal-grade paper, high-quality graphic arts products, and specialty coated papers.

The company has a chemical plant, converting/coating/finishing plants, and capsular plants. Although carbonless paper has long been Appleton's bread and butter, the company announced in early 1989 that it would establish a business unit dedicated solely to thermal paper. This area of Appleton's business is thriving with the proliferation of facsimile machines and bar-coded pressure-sensitive labels. In 1988, the company added a thermal paper coating machine at its finishing plant in Appleton, Wis., which more than doubled company-wide thermal paper capacity.

Since acquiring the West Carrollton, Ohio, mill in 1984, Appleton has rebuilt all three of its paper machines and dedicated them solely to producing carbonless paper. In 1990, the company invested $14 million at this site to increase production of recycled paper. In the same year, the company introduced Recover, the first 50% recycled carbonless and thermal paper, containing 10% postconsumer wastepaper.

In September 1990, the company announced plans to buy the Vancouver, Wash., paper mill from Boise Cascade Corp. for about $60 million. The 105,000-tpy acquisition would have increased the company's carbonless capacity by about 20%. In spring 1991, the Federal Trade Commission ruled that such a purchase would be anticompetitive.

Production facilities:

WEST CARROLLTON, OHIO
(West Carrollton mill)
Pulp—180 tpd bleached deinked
Carbonless paper—350 tpd

ROARING SPRING, PA.
(Spring mill)
Pulp—200 tpd bleached kraft
Carbonless paper—210 tpd

COMBINED LOCKS, WIS.
(Locks mill)
Pulp—200 tpd chemimechanical
Carbonless paper—530 tpd

Total production capacity:

PULP	
Kraft	200 tpd
Chemimechanical	200 tpd
Deinked	180 tpd
Total	580 tpd
PAPER	1,090 tpd

Boise Cascade Corp.

One Jefferson Sq.
P.O. Box 50
Boise, Idaho 83728-0001
John B. Fery, chairman/chief executive officer

(Boise owns Boise Cascade Canada.)

(million $)

	Net sales	Net earnings
1990	$4,185.9	$75.2
1989	4,338.0	267.5
1988	4,094.6	289.1
1987	3,820.8	182.9
1986	3,739.9	101.5

In 1990, Boise Cascade unveiled "A Blueprint for the '90s," which details five specific business objectives it will pursue in the coming decade. The first objective is to focus expansion activity on the lucrative white papers business—uncoated free-sheet, uncoated groundwood, coated free-sheet, and coated groundwood. In December 1990, Boise started up a new machine at its mill in International Falls, Minn., which increases uncoated white paper capacity by 30%, or 300,000 tpy. In addition, the company intends to eventually install a 320,000-tpy coated groundwood machine at its mill in Rumford, Maine.

Objective No. 2 is to continue investing in pulp and paper mills with existing, or potential for, excellence in terms of cost and quality. Objective No. 3 is to reduce pulp and paper exposure in the Pacific Northwest, where environmental pressures have led to a decrease in the availability and increase in the cost of woodchips. In an attempt to increase woodchip self-sufficiency, Boise purchased a whole-log chipping facility in northeastern Oregon in 1990.

In September 1991, Boise agreed to sell essentially all of its wholesale office products distribution business, while retaining its consumer office products business. Previously, Boise had stated its intention to invest $60 million/year over the next few years to realize its fourth objective, expansion in the office products distribution business. The fifth objective is to continue to invest in its building products business. The company has invested over $400 million in this area in the past ten years and plans to allocate an additional $40 million/year to further improve and expand this business.

Paper, paper/board, and converted products accounted for 53% of the company's total sales in 1990. Operating income for paper and paper products was $187 million, down from $405 million in 1989. Pulp and paper sales volume was about 3.4 million tons in 1990.

The company's capital expenditures totaled over $4.3 billion during the 1979-89 period. Boise spent another $662 million in 1990 but earmarked just $300 million for capital spending in 1991.

Boise owns 2.8 million acres of timberland, and it controls an additional 3.3 million acres through long-term leases, contracts, and licenses.

Production facilities:

White Paper Div.

JACKSON, ALA.
(Former Allied Paper Co. mill)
Pulp—589 tpd bleached kraft (365 for market)
Uncoated free-sheet—253 tpd

INTERNATIONAL FALLS, MINN.
Pulp—839 tpd bleached kraft
Uncoated free-sheet—982 tpd

ST. HELENS, ORE.
Pulp—961 tpd bleached kraft (222 for market)
Uncoated free-sheet—610 tpd

VANCOUVER, WASH.
Uncoated free-sheet—298 tpd

WALLULA, WASH.
Pulp—829 tpd bleached kraft (345 tpd for market); 190 tpd semichemical
Uncoated free-sheet—540 tpd
Corrugating medium—302 tpd

Coated & Specialty Converting Paper Div.

RUMFORD, MAINE
Pulp—1,011 tpd bleached kraft; 150 tpd groundwood;
Coated paper—1,153 tpd
Uncoated free-sheet—352 tpd

Publishing & Packaging Paper

DeRIDDER, LA.
(Boise Southern Co.)
Pulp—1,211 tpd unbleached kraft; 304 tpd bleached kraft; 413 tpd groundwood; 403 tpd thermomechanical
Newsprint—1,091 tpd
Linerboard—1,195 tpd

STEILACOOM, WASH.
Pulp—442 tpd thermomechanical
Newsprint—536 tpd

FORT FRANCES, ONT.
(Boise Cascade Canada)
Pulp—470 metric tpd (518 short) groundwood; 537 metric tpd (592 short) bleached kraft (330 short tpd for market)
Uncoated groundwood papers—707 metric tpd (779 short)

KENORA, ONT.
(Boise Cascade Canada)
Pulp—556 metric tpd (613 short) groundwood; 286 metric tpd (316 short) sulfite
Newsprint—865 metric tpd (954 short)

Total production capacity:

PULP	
Kraft	6,336 tpd
Groundwood	1,694 tpd
TMP	845 tpd
Sulfite	316 tpd
Semichemical	190 tpd
Total	9,381 tpd

PAPER AND BOARD	
Uncoated free-sheet	3,035 tpd
Newsprint	2,581 tpd
Coated	1,153 tpd
Uncoated groundwood	779 tpd
Containerboard	1,497 tpd
Total	9,045 tpd

Bowater Inc.

One Parklands Dr., Box 4012
Darien, Conn. 06820-1412
Anthony P. Gammie,
chairman/president/chief executive officer

(Bowater owns 51% of Calhoun Newsprint Co. [Newhouse Newspaper Group, 49%] and 51% of Mersey Paper Co. Ltd. [The Washington Post, 49%].)

(million $)

	Net sales	Net earnings
1990	$1,380.4	$78.3
1989	1,449.9	144.5
1988	1,410.4	164.3
1987	1,231.0	81.1
1986	919.7	49.4

Spun off by its English parent as an independent company in 1984, Bowater is a major producer of newsprint (about 61% of its capacity), coated publication paper (20%), and market pulp (19%). It is the largest manufacturer of newsprint in the U.S. and about the sixth largest in North America. Bowater has diversified into the forms business, doubling operations in 1987 through the acquisition of Star Forms.

Sales in 1990 were $617 million for newsprint, $279 million for coated paper, $171 million for pulp, $281 million for communication papers, and $33 million for timber and other products. Production in 1990 (including affiliates) was 1,615,000 tons of paper and paperboard and 307,000 tons of market pulp.

Capital expenditures in 1990 were $214 million, compared with $423 million in 1989. The company planned to spend about $170 million in 1991. Bowater is presently evaluating a partnership with the Venezuelan government and newspaper publishers to build a 200,000-tpy greenfield newsprint mill. The company was led to reassess the prospect of full participation when Abitibi-Price Inc. formally withdrew from negotiations in 1990.

Bowater Southern's expansion and modernization of its pulp and paper complex in Calhoun, Tenn., culminated in the February 1990 startup of a new 915-tpd (325,000-tpy) bleached kraft pulp mill. The renovation of this facility served to increase Bowater's market pulp capacity by 78,000 tpy. A $75-million deinking project to be completed in late 1991 will enable one of Calhoun's five newsprint machines to produce 40% recycled-content newsprint.

In late 1989, Bowater Mersey Paper Co. commissioned a new 700-tpd thermomechanical pulp (TMP) mill at its newsprint mill at Liverpool (Brooklyn), N.S. This new TMP mill replaced the groundwood and sulfite mills. Furnish to the paper machines is now 100% TMP. However, efforts to increase the speed of the mill's two machines were encumbered by operational problems, and operating rates averaged just 86% in 1990.

In October 1991, Bowater agreed to pay $300 million in cash for an 80% interest in Georgia-Pacific Corp.'s Great Northern Paper Inc.'s newsprint and groundwood paper mills. Also included in the deal are associated hydroelectric assets and about $2.1 million in timberland.

Bowater owns 1.67 million acres of timberland and controls an additional 200,000 acres.

Production facilities:

CATAWBA, S.C.
(Bowater Carolina Co.)
Pulp—1,300 tpd bleached kraft (720 tpd for market); 1,000 tpd thermomechanical
Coated publication paper—960 tpd
Newsprint—680 tpd

CALHOUN, TENN.
(Bowater Southern Paper Co.)
Pulp—900 tpd semibleached kraft (220 tpd for market pulp); 700 tpd groundwood; 335 tpd thermomechanical
Newsprint—1,615 tpd

CALHOUN, TENN.
(Calhoun Newsprint Co.)
Pulp—710 tpd thermomechanical
Newsprint—666 tpd

LIVERPOOL (Brooklyn), N.S.
(Bowater Mersey Paper Co.)
Pulp—880 tpd thermomechanical
Newsprint—725 tpd

Total production capacity:

PULP	
Kraft	2,200 tpd
Groundwood	700 tpd
Thermomechanical	2,925 tpd
Total	5,825 tpd

PAPER (short tons)	
Coated	960 tpd
Newsprint	3,686 tpd
Total	4,646 tpd

Brant-Allen Industries Inc.

(Formerly Bato Co. Inc.)
80 Field Point Rd.
Greenwich, Conn. 06830
Peter M. Brant, chief executive officer

(F.F. Soucy Inc. is a wholly owned subsidiary. Brant-Allen owns 50% of F.F. Soucy Inc. et Associés [Dow Jones owns 40% and Rexfor 10%]. Brant-Allen is joint owner of Bear Island Paper Co. with Dow Jones and Washington Post.)

Financial data not available.

A new 225,000-tpy, $400-million newsprint machine and pulp mill are still under consideration for Bear Island Paper in Ashland, Va. And the company has said that it will install deinking facilities there once a pattern of state recycling laws and market needs has been established. Based on the same criteria, F.F. Soucy Inc. et Associés' mill in Rivière-du-Loup, Que., also plans to install deinking facilities. In addition, the company is considering a plan to rework the press section on No. 1 machine and install a new pickup combination press, which would add 9,000 tpy to capacity.

Recently, Brant-Allen was identified by *Paper* magazine as a potential investor studying installation of a supercalendered uncoated groundwood paper machine at the idled Port Cartier BCTMP mill.

The company owns 235,000 acres of timberland in U.S.

Production facilities:

ASHLAND, VA.
(Bear Island Paper Co.)
Pulp—600 tpd thermomechanical
Newsprint—610 tpd

RIVIORE-du-LOUP, QUE.
(F.F. Soucy Inc.)
Pulp—540 metric tpd (595 short) thermomechanical
Newsprint—150 metric tpd (165 short)

RIVIÈRE-du-LOUP, QUE.
(F.F. Soucy Inc. et Associés)
Newsprint—420 metric tpd (463 short)

Total production capacity:

PULP	
TMP	1,195 tpd
PAPER	
Newsprint	1,238 tpd

Canadian Pacific Forest Products Limited

1155 Metcalfe St.
Montreal, Que. H3B 2X1
Paul E. Gagne, president/chief executive officer

(Canadian Pacific Forest Products Ltd. was formed in April 1988 by a merger of CIP Inc. and Great Lakes Forest Products Ltd. At the time, Canadian Pacific Ltd. wholly owned CIP and held 54.3% of Great Lakes, giving it 79.7% ownership of the new company. CP Forest owns 77.7% of Gold River Newsprint Ltd., 67% of NBIP Forest Products Inc., and 40% of Ponderay Newsprint Co.)

(million C$)

	Net sales	Net earnings
1990	C$2,313.4	C$-9.4
1989	2,876.4	220.1
1988	3,005.9	323.4
1987	2,764.7	214.0
1986	2,316.7	33.3

Canadian Pacific Forest Products is one of the world's largest integrated forest products companies. It manufactures a wide range of forest products, including newsprint and uncoated mechanical paper, pulp, paperboard and packaging materials, white paper, tissue products, and lumber.

In 1990, the company's sales were C$2.3 billion, and year-end total assets exceeded C$3 billion. About 87% of sales came from newsprint, pulp, and paperboard products. In 1990, production of paper and paperboard products was 1.7 million metric tons. Pulp production was roughly 700,000 metric tons.

Capital expenditures in 1990 were C$426 million. The company planned to spend C$450 million in 1991.

CP Forest recently completed a C$350-million modernization program at Thunder Bay, Ont. A 245,000-metric-tpy thermomechanical pulp mill replaced a groundwood pulp mill in fall 1990, and a 240,000-metric-tpy high-speed newsprint machine replaced two older machines in May 1991, increasing capacity to 477,000 metric tpy.

At the newsprint facility in Gatineau, Que, a C$210-million project to improve efficiencies and convert production to recycled newsprint is scheduled to begin after repulping and deinking facilities are installed at the site.

In third-quarter 1991, CP Forest sold Facelle Co., its tissue division, to Procter & Gamble for C$185 million. The company also announced in June 1991 that it was looking to sell its packaging operations. With 1,717,098 acres of forest and an additional 25 million acres held under government license, CP Forest is the largest holder of timber-cutting rights in Ontario and a major forest landowner in British Columbia, Quebec, and New Brunswick.

Production facilities:

GOLD RIVER, B.C.
Pulp—710 metric tpd kraft (for market)
(Gold River Newsprint Ltd. Partnership)
Newsprint—635 metric tpd (1989 startup)

DALHOUSIE, N.B.
(NBIP Forest Products Inc.)
Pulp—600 metric tpd stone groundwood; 430 metric tpd SCMP
Newsprint—1,045 metric tpd

DRYDEN, ONT.
Pulp—800 metric tpd bleached and unbleached kraft (300 tpd for market)
Tissue paper—800 metric tpd

GATINEAU, QUE.
Pulp—600 metric tpd stone groundwood; 450 metric tpd refiner groundwood; 550 metric tpd chemimechanical
Newsprint—1,700 metric tpd

LA TUQUE, QUE.
Pulp—1,800 metric tpd kraft (475 tpd for market)
Kraft paperboard—688 metric tpd
Solid bleached board—288 metric tpd

MATANE, QUE.
Pulp—225 metric tpd semichemical
Semichemical corrugating medium—300 metric tpd

THUNDER BAY, ONT.
Pulp—1,335 metric tpd bleached kraft (for market); 325 metric tpd high-yield sulfite; 1,000 metric tpd groundwood
Newsprint—1,300 metric tpd

TROIS RIVIERES, QUE.
Pulp—260 metric tpd sulfite; 750 metric tpd groundwood
Groundwood specialties—920 metric tpd

USK, WASH.
(Ponderay Newsprint Co.)
Pulp—700 metric tpd groundwood
Newsprint—580 metric tpd

Total production capacity:

PULP	
Kraft	4,645 metric tpd
Groundwood	4,100 metric tpd
SCMP	665 metric tpd
Chemimechanical	550 metric tpd
Sulfite	585 metric tpd
Total	10,535 metric tpd
PAPER AND BOARD	
Newsprint	5,260 metric tpd
Groundwood specialties	920 metric tpd
Uncoated free-sheet paper	800 metric tpd
Containerboard	988 metric tpd
Solid bleached board	288 metric tpd
Total	8,256 metric tpd

Canfor Corp.

2800—1055 Dunsmuir St.
P.O. Box 49420, Bentall Postal Station
Vancouver, B.C. V7X 1B5
Peter J.G. Bentley, chairman/chief executive officer

(Canadian Forest Products Ltd. is a wholly owned subsidiary. Howe Sound Pulp & Paper Ltd. is a 50%-owned affiliate.)

(million C$)

	Net sales	Net earnings
1990	C$884.3	C$3.7
1989	921.2	96.3
1988	1,084.2	180.0
1987	1,244.9	102.7
1986	1,046.7	23.7

Canfor is one of Canada's largest producers of market pulp and lumber. After three years of excellent earnings, Canfor's

1990 results declined substantially because of deteriorating pulp and paper markets and weak lumber markets.

Canfor pulp and paper sales were C$291 million in 1990, which was 33% of total sales. Canfor produced about 326,000 metric tons of market pulp in 1990 (this figure does not include production of Howe Sound Pulp & Paper Ltd.) and about 90,000 metric tons of kraft paper.

Canfor derives the majority of its revenues from its wood products businesses. In 1990, the company had over C$360 million in lumber sales, producing 1.43 billion bd ft.

Capital expenditures in 1990 totaled C$105.3 million, 55% of which was used for pulp and papermaking facilities. The company planned to reduce expenditures to C$60 million in 1991.

The new pulp mill at Howe Sound Pulp and Paper Ltd., jointly owned by Canfor and Oji of Japan, has started up and is working its way toward 1,000 tpd. A 585-tpd newsprint machine started up in early April 1991 and began producing salable newsprint at an early stage.

Canfor owns 2,291 hectares of timberland and controls an additional 958,000 hectares.

Production facilities:
(Does not include new TMP newsprint mill at Howe Sound)

PORT MELLON, B.C.
(Howe Sound Pulp & Paper Ltd., formerly Howe Sound Pulp Div.)
Pulp—1,000 metric tpd bleached kraft (for market)

PRINCE GEORGE, B.C.
(Intercontinental Pulp)
Pulp—685 metric tpd bleached and unbleached kraft (for market)

PRINCE GEORGE, B.C.
(Prince George Pulp & Paper)
Pulp—500 metric tpd bleached and unbleached kraft (for market)
Sack paper—295 metric tpd

Total production capacity:

PULP	
Market	2,185 metric tpd
PAPER	
Sack	295 metric tpd

Caraustar Industries Inc.

Washington St., Box 115
Austell, Ga. 30001
James G. Dalton, chairman/chief executive officer

(Settsu Corp., Japan's leading producer of recycled paperboard, has about a 24% minority interest in Caraustar.)

Financial data not available.

Caraustar is a privately owned holding company that has recycled paperboard mills and converting plants. It is about the fifth largest U.S. producer of recycled paperboard, and its recycled paperboard mills have a total capacity of about 600,000 tpy. In 1990, Caraustar produced an estimated 575,000 tpy of paperboard and collected roughly 600,000 tpy of wastepaper.

Production facilities:

AUSTELL, GA.
(Austell Box Board Corp.)
Recycled paperboard—425 tpd

AUSTELL, GA.
(Sweetwater Paper Board Co.)
Recycled paperboard—375 tpd

CAMDEN, N.J.
(Camden Paperboard Corp.)
Gypsum board—130 tpd

CHICAGO, ILL.
(Chicago Paperboard Corp.)
Recycled paperboard—200 tpd

CHARLOTTE, N.C.
(Carolina Paper Board Corp.)
Recycled paperboard—150 tpd

CINCINNATI, OHIO
(Cincinnati Paperboard Corp.)
Recycled paperboard—200 tpd

SINKING SPRING, PA.
(Reading Paper Board Corp.)
Recycled paperboard—47 tpd

TAYLORS, S.C.
(Carotell Paper Board Corp.)
Recycled paperboard—185 tpd

CHATTANOOGA, TENN.
(Chattanooga Paperboard Corp.)
Recycled paperboard—150 tpd

Total production capacity:

PAPERBOARD	1,862 tpd

Cascades Inc.

404 Marie-Victorin St.
Box 30
Kingsey Falls, Que. J0A 1B0
Bernard Lemaire, president

(million C$)

	Net sales	Net earnings
1990	C$818.0	C$20.1
1989	681.6	29.8
1988	588.7	39.1
1987	527.7	34.1
1986	440.1	33.7

Founded in 1964, Cascades has grown rapidly through a series of acquisitions in eastern Canada, the U.S., France, Belgium, and Sweden. The company is controlled by the Lemaire family of Quebec, who originally started in the wastepaper business. The company's product line includes pulp and kraft paper, toilet paper and paper towels, corrugating medium, boxboard, egg trays, roofing insulating paper, health and hygiene products, and plastics.

Cascades' capital expenditures in 1990 totaled C$93 million. In 1991, however, the company decreased its budget by nearly 20% to C$75 million.

In a 50:50 joint venture, Rexfor and Cascades acquired the closed Port-Cartier, Que., mill from ITT Rayonier Inc. in 1986. With the help of government funds, the mill was converted from sulfite pulp to bleached chemi-thermomechanical pulp by 1988. Despite a $20-million loss at this facility in 1990 (attributed to market conditions and papermakers' half-hearted reception of BCTMP), Cascades and Rexfor each invested C$13.3 to maintain the mill during 1991. The continued slump in BCTMP pricing led to its closure in May 1991. Low pulp prices also led to the shutdown of the NBSK pulp mill at Jonquiere, Que., later in 1991.

The company controls approximately 1,550,000 acres of timberland in Canada.

Production facilities:

BRANTFORD, ONT.
(Cascades Dominion Inc.)
Molded pulp (egg cartons)—44 tpd

BREAKEYVILLE, QUE.
(Désencrage Cascades Inc.)
Pulp—100 metric tpd deinked (for market)

CABANO, QUE.
(Papier Cascades [Cabano] Inc.)
Corrugating medium—300 metric tpd

DRUMMONDVILLE, QUE.
(Cascades P.S.H. Inc.)
Sanitary napkins—adult diapers

EAST ANGUS, QUE.
(Cascades [East-Angus] Inc.)
Pulp—220 metric tpd unbleached kraft; 120 metric tpd semichemical
Brown kraft paper—240 short tpd
Folding boxboard—85 metric tpd

JOLIETTE, QUE.
(Cascades [Joliette] Inc.)
Sheathing, indenting paper—70 tpd

JONQUI`ERE, QUE.
(Cascades [Jonquière] Inc.)
Pulp—245 tpd bleached and 265 tpd of unbleached kraft (60 tpd for market); 120 tpd BCTMP
Boxboard—300 tpd

KINGSEY FALLS, QUE.
(Cascades Paper Inc.)
Corrugating medium—100 metric tpd
Molded pulp products—32 metric tpd

KINGSEY FALLS, QUE.
(Les Industries Cascades Ltee.—joint venture with Wyant Co.)
Industrial toweling—85 tpd
Sanitary tissue—55 tpd

KINGSEY FALLS, QUE.
(Papier Kingsey Falls)
Chipboard-linerboard—130 tpd

LOUISEVILLE, QUE.
(Matériaux Cascades Inc.)
Pulp-unbleached groundwood—40 tpd
Construction board—180 metric ft^2

PORT-CARTIER, QUE.
(Cascades [Port-Cartier] Inc.—joint venture with Rexfor)
Pulp—500 metric tpd bleached chemi-thermomechanical (shut down 5/91)

NIAGARA FALLS, N.Y.
(Cascades Niagara Falls Inc.—former Nitec Paper Corp. mill)
Corrugating medium—230 short tpd (209 metric)

ROCKINGHAM, N.C.
(Cascades Industries Inc.)
Tissue—60 short tpd (54 metric)

THORNDIKE, MASS.
(Cascades Diamond Inc.)
Molded pulp products

Total production capacity:

PULP	
Kraft	870 metric tpd
Semichemical	120 metric tpd
TMP, BCTMP	620 metric tpd
Deinked	116 metric tpd
Total	1,726 metric tpd
PAPER AND BOARD	
Tissue/toweling	194 metric tpd
Kraft packaging	240 metric tpd
Corrugating medium	609 metric tpd
Boxboard	385 metric tpd
Industrial paper/board	200 metric tpd
Total	1,628 metric tpd

Champion International Corp.

One Champion Plaza
Stamford, Conn. 06921
Andrew C. Sigler, chairman/chief executive officer

(Champion owns 84.6% of Weldwood of Canada Ltd., which in turn owns 50% of Cariboo Pulp & Paper Co.; Marubeni-Daishowa International Ltd. owns the other 50%.)

(million $)

	Net sales	Net earnings
1990	$5,090.0	$223.6*
1989	5,163.2	432.4
1988	5,128.5	456.4
1987	4,614.7	382.0**
1986	4,387.6	200.8

*Includes $23-million nonrecurring loss.
**Includes $88.7-million net gain from sale of assets.

Champion International is emphasizing growth in the printing/writing grades following the sale of all but one of its unbleached kraft packaging mills. Its merger with St. Regis Paper Co. in 1984 focused Champion on being primarily a pulp and paper company and combined Champion's strength in coated and uncoated free-sheet grades with St. Regis' strength in uncoated groundwood grades, lightweight coated publication papers, and newsprint.

Since the merger, however, several mills have been sold: Battle Creek, Mich., and St. Paul, Minn., to Waldorf Corp.; Ontonagon, Mich., Missoula, Mont., and York, Pa., to Stone Container Corp.; Pasadena, Texas, and Tacoma, Wash., to Simpson Paper Co.; Little Falls, Minn., to Carlyle Investment Corp.; and Columbus, Ohio, to Du Pont Co.'s Industrial Imaging Systems Div.

In early 1988, Weldwood of Canada Ltd. got approval from shareholders to purchase Champion's St. Regis Paper Co. (Canada) Ltd., which includes Champion Forest Products (Alberta) Ltd. (of which the Hinton, Alta., market pulp mill is a part) and St. Regis Resources Ltd. (oil and gas). In exchange, Champion's share in Weldwood increased from 71.8% to 84.6%.

Net sales of paper products in 1990 were $4.1 billion, constituting 81% of total company sales. 1990 North American paper and board production included 286,000 tons of coated free-sheet paper, 1.1 million tons of uncoated free-sheet paper, 931,000 tons of publication papers, 820,000 tons of newsprint, 150,000 tons of kraft papers, 330,000 tons of linerboard, 245,000 tons of bleached board.

The company devoted approximately $1 billion to capital expenditures in 1990. With weak market conditions in the pulp, paper, and wood products industries, however, Champion has moderated spending plans in 1991 and 1992 to $650 million/year.

The C$360-million pulp expansion project at Weldwood's Hinton, Alta., mill experienced some operational difficulties after startup in 1990 but was running near design capacity by year end. The project nearly doubled the mill's annual capacity to 424,000 tpy of bleached softwood pulp. Champion's mill in Courtland, Ala., is nearing the end of a $565-million, four-year modernization and expansion program, which will increase pulp capacity by 46% and paper capacity by 22%. The expansion includes a cogeneration project to provide near self-sufficiency in electrical power.

Implementation of a $270-million restructuring project to downsize the company's Canton, N.C., pulp mill finally got the go-ahead in April 1990. The project is expected to take three years to complete and improve the facility's environmental performance. By 1993, the Sheldon, Texas, newsprint mill will be making recycled-content newsprint when its new $85-million, 145,000-tpy deinking plant comes online.

Champion has, at least temporarily, shelved the following expansion plans due to weak market conditions: installation of $390-million coated free-sheet machine in Courtland, a new coated publication paper machine at Sartell, and the conversion of the Roanoke Rapids linerboard/kraft facility to white papers.

Champion owns 6,017,000 acres of timberland in the U.S. and Canada and controls an additional 645,000 acres.

Production facilities:

COURTLAND, ALA.
(Paper Div.)
Pulp—1,450 tpd kraft
Uncoated and coated printing/writing and converting paper—1,550 tpd

PENSACOLA (Cantonment), FLA.
(Printing & Writing Div.)
Pulp—1,850 tpd bleached kraft (550 for market)
Uncoated free-sheet paper—1,054 tpd

BUCKSPORT, MAINE
(Publication Papers)
Pulp—300 tpd groundwood; 150 tpd thermomechanical
Publication papers—1,150 tpd

QUINNESEC, MICH.
Pulp—750 bleached hardwood kraft (for market)

SARTELL, MINN.
(Publication Papers)
Pulp—250 tpd thermomechanical
Publication papers—710 tpd (480 tpd coated, 230 tpd uncoated)

DEFERIET, N.Y.
(Publication Papers)
Pulp—310 tpd groundwood
Publication papers—605 tpd

CANTON, N.C.
(Paper Div.)
Pulp—1,450 tpd bleached kraft
Uncoated printing/writing and converting paper—819 tpd
Bleached paperboard—705 tpd

ROANOKE RAPIDS, N.C.
(Packaging Div.)
Pulp—1,300 tpd unbleached kraft
Unbleached kraft paper—596 tpd
Unbleached linerboard—763 tpd

HAMILTON, OHIO
(Paper Div.)
Uncoated and coated printing/writing and converting paper—530 tpd

HOUSTON, TEXAS
(Newsprint Div., Sheldon mill)
Pulp—575 tpd kraft (unbleached 300 tpd, bleached 350 tpd); 600 tpd groundwood; 400 tpd thermomechanical
Newsprint—1,330 tpd

LUFKIN, TEXAS
(Newsprint Div., Lufkin Mill)
Pulp—545 tpd unbleached kraft (501 tpd semibleached); 800 tpd groundwood
Newsprint—920 tpd
Directory paper—300 tpd

HINTON, ALTA.(—See Weldwood of Canada Ltd.)

QUESNEL, B.C.
(Cariboo Pulp & Paper Co.—See Daishowa America Co. and Weldwood of Canada Ltd.)

Total production capacity:
(Does not include Weldwood of Canada.)

PULP	
Kraft	7,920 tpd
Groundwood	2,010 tpd
TMP	800 tpd
Total	10,730 tpd
PAPER	
Newsprint	2,250 tpd
Printing/writing and converting	3,953 tpd
Publication papers	2,465
Directory	300 tpd
Kraft	596 tpd
Total	9,564 tpd
PAPERBOARD	
Bleached	705 tpd
Linerboard	763 tpd
Total	1,468 tpd
TOTAL PAPER/BOARD	11,032 tpd

Chesapeake Corp.

1021 E. Cary St., Box 2350
Richmond, Va. 23218-2350
J. Carter Fox, president/chief executive officer
Sture G. Olsson/chairman of the board

(million $)

	Net sales	Net earnings
1990	$841.0	$17.0
1989	813.1	47.6
1988	711.3	51.5
1987	675.7	30.2
1986	599.8	13.7

From only one mill at West Point, Va., Chesapeake underwent a dramatic change in 1985 with its $210-million purchase of Wisconsin Tissue Mills Inc. and Plainwell Paper Co. from Philip Morris Inc. This extended its original product line of linerboard, kraft paper, and hardwood market pulp to include commercial/industrial tissue and coated and uncoated specialty and premium printing papers. In late 1987, Chesapeake sold Plainwell to Simpson Paper Co., eliminating printing and special industrial papers from its line. The company currently focuses on kraft products that emphasize white-top specialty products and products using recycled paper, as well as tissue products, packaging, and treated wood.

Chesapeake has been described as having grown from "an old-line box maker to a high-profit niche player."

Paper sales in 1990 were $464 million, which was 55% of total sales. Converted products sales, which included corrugated boxes, were $273 million, or 32% of total sales. Wood products accounted for the remaining 12% of sales.

Capital expenditures in 1990 were $125 million, about $15 million less than the amount spent in 1989. The company expected to further reduce spending to $105 million in 1991.

In 1988, Chesapeake began a $160-million expansion at Wisconsin Tissue Mills, which included a new 80,000-tpy tissue machine. The new machine, which raises capacity to about 195,000 tpy, started up in mid-1990. At the mill in West Point, Va., a new $100-million recovery boiler is to be installed by mid-1992, allowing Chesapeake to increase its emphasis on white-top paperboard products at West Point.

Chesapeake owns 350,000 acres of timberland.

Production facilities:

WEST POINT, VA.
Pulp—1,450 tpd softwood and hardwood kraft (480 tpd bleached for market)
Kraft paper—350 tpd
Containerboard—990 tpd

MENASHA, WIS.
(Wisconsin Tissue Mills Inc.)
Pulp—deinking
Tissue—550 tpd

Total production capacity:

PULP	1,450 tpd
PAPER AND BOARD	1,890 tpd

Consolidated Papers Inc.

Box 8050
Wisconsin Rapids, Wis. 54495-8050
George W. Mead, chairman/chief executive officer

(million $)

	Net sales	Net earnings
1990	$948.8	$142.5
1989	952.5	167.9
1988	896.8	149.9
1987	742.8	95.8
1986	653.0	87.5

Consolidated Papers is a leading producer of coated free-sheet and lightweight coated groundwood grades. Ongoing capital expenditure projects are the key to Consolidated's strategy to improve productivity and quality at its five Wisconsin mills. They have enabled the company to retain its reputation as a low-cost, high-quality producer.

Total paper and paperboard shipments in 1990 were 980,274 tons. Enamel papers accounted for 854,307 tons; specialty papers, 55,360 tons; and paperboard, 5,334 tons. Kraft (Wisconsin Rapids, Wis.) Div. supplied 293,479 tons of chemical pulp in 1990. Total pulp production was 481,830 tons.

Capital spending in 1990 was $331.1 million, and $300.0 million was authorized for 1991.

In March 1989, the company broke ground for No. 34, a $135-million lightweight coated specialty paper machine at its Stevens Point, Wis., Div. The 59,000-tpy machine came online in late 1990 and doubles the mill's capacity. Improvements made at the Kraft Div. in July 1991 should bring pulp production to 950 tpd by the end of the year. The Wisconsin Rapids Div. is the site of a new $495-million, 212,000-tpy coated free-sheet paper machine, which is scheduled to come online in March 1992.

Consolidated owns 315,424 acres of timberland in the U.S. and another 356,927 acres in Canada.

Production facilities:

STEVENS POINT, WIS.
(Stevens Point Div.)
Specialty paper—330 tpd

STEVENS POINT, WIS.
(Wisconsin River Div.)
Pulp—272 tpd groundwood
Book paper—628 tpd

WISCONSIN RAPIDS, WIS.
(Wisconsin Rapids Div.)
Enamel paper—723 tpd
Paperboard—105 tpd

WISCONSIN RAPIDS, WIS.
(Biron Div.)
Pulp—553 tpd groundwood
Book paper—1,069 tpd

WISCONSIN RAPIDS, WIS.
(Kraft Div.)
Pulp—900 tpd kraft

Total production capacity:

PULP	
Groundwood	825 tpd
Kraft	900 tpd
Total	1,725 tpd

PAPER & BOARD	
Enamel paper	2,420 tpd
Specialty paper	330 tpd
Paperboard	105 tpd
Total	2,855 tpd

Daishowa International

(Subsidiary of Daishowa Paper Manufacturing Co. Ltd., Japan)
Yomoji Saito, president

Daishowa Paper Manufacturing Co. Ltd. is the second largest paper and board producer in Japan. It has been assiduously acquiring assets in North America, often in the form of joint-venture partnerships.

Financial data not available.

U.S. Operations

Daishowa America Co. Ltd.
7200 Columbia Center
Seattle, Wash. 98104
Steve Taniguchi, executive vice president

In the U.S., Daishowa's principal holding is the Port Angeles uncoated groundwood mill in northwestern Washington. The mill produces about 155,000 tpy on two machines, both of which were rebuilt in the last six years. Daishowa is reorienting the mill to recycled-content production. A $40-million recycled-paper plant, scheduled to come online in mid-1992, will help the mill produce paper comprised of 40% recycled fiber, diminishing Port Angeles' dependence upon virgin fiber.

Canadian Operations

Daishowa Canada Co. Ltd.
Box 11595, 650 W. Georgia St.
Vancouver, B.C. V6B 4N8

Daishowa Forest Products Ltd.
207 Queens Quay West, Ste. 880
Toronto, ONT. M5J 1A7
Koichi Kitagawa, chief executive officer

Daishowa's Peace River mill, located 300 miles north of Edmonton, Alta., began production in mid-1990. It has a rated capacity for about 375,000 metric tpy of air-dry bleached kraft pulp.

In Quebec City, Que., the company invested roughly $60 million to build a recycling plant. Upon completion in 1992, the mill will have a projected capacity of 72,000 metric tpy of recycled-content telephone directory paper. Once the recycled plant is online, Daishowa plans to close down the facility's sulfite pulp mill.

Production facilities:

PORT ANGELES, WASH.
(Daishowa America Co. Ltd.)
Pulp—436 metric tpd stone groundwood, TMP
Directory paper—390 metric tpd

QUESNEL, B.C.
(Cariboo Pulp & Paper Co.—25% ownership)
Pulp—950 metric tpd bleached kraft
(Daishowa-Marubeni's share: 237 metric tpd)

QUESNEL, B.C.
(Quesnel River Pulp Co.—50% ownership)
Pulp—950 metric tpd TMP and BCTMP
(Daishowa Canada's share: 475 metric tpd)

QUEBEC CITY, QUE.
(Daishowa Forest Products, Ltd.)
Pulp—1,350 groundwood/TMP, 400 metric tpd sulfite (92 tpd for market)
Newsprint—1,437 tpd
Boxboard—139 tpd

PEACE RIVER, ALTA.
(Daishowa Canada Co. Ltd.)
Pulp—950 metric tpd bleached hardwood kraft market pulp

Total production capacity:

PULP	
Kraft	1,900 metric tpd
Groundwood/TMP/BCTMP	2,736 metric tpd
Sulfite	400 metric tpd
Total	5,036 metric tpd
PAPER AND BOARD	1,966 metric tpd

Domtar Inc.

395 de Maisonneuve Blvd. W.
Montreal, Que. H3A 1L6
Jean Campeau, chairman
Pierre Desjardins, chief executive officer

(Forty-four percent of Domtar is jointly owned by Caisse de Dépôt du Placement du Québec, and Soc. Générale de Financement du Québec.)

(million C$)

	Net sales	Net earnings
1990	C$2,314	C$-294
1989	2,515	33
1988	2,703	111
1987	2,568	161
1986	2,327	145

Domtar is a producer of pulp, paper, lumber, packaging, and construction materials. An organizational program was initiated in 1989 to further reduce the number of management levels and to simplify the way business is done. The company divested its Chemicals Group and oil and gas businesses. To take advantage of the next period of growth, Domtar will continue in 1991 to improve its cost competitiveness. All units are being profiled against the leading North American competition in their respective industries, and plans of action are being developed to reduce cost differentials. Facilities deemed no longer cost-efficient have been, or will be, closed as market conditions indicate.

During the past three years, Domtar's Pulp & Paper Products Group has accounted for about 55% of consolidated sales, while its Packaging Group generated about 19% of these sales during the same period.

Domtar is Canada's largest manufacturer of fine papers, with sales in 1990 of C$820 million. Newsprint and groundwood specialties sales were C$313 million; market pulp and lumber sales were C$138 million, and packaging products sales were C$430 million.

In 1990, the company produced 586,000 metric tons of fine and specialty papers, 403,000 metric tons of newsprint, 132,000 metric tons of market pulp, and 419,000 metric tons of containerboard.

A $1-billion rehabilitation at the fine papers complex at Windsor, Que., came online late in 1989. Two new paper machines increased capacity to 350,000 tpy, but the facility has had difficulty reaching target cost-efficiency levels.

Capital spending in 1990 reached C$215 million. The company projects expenditures to decrease to C$75 million in 1991.

Domtar owns 995,000 acres of timberland in Canada and the U.S., and it has cutting rights on another 7.7 million acres in Canada.

Production facilities:

Pulp & Paper Products Group:

CORNWALL, ONT.
(Specialty Papers Div.)
Pulp—333 metric tpd kraft
Fine paper—756 metric tpd

ST. CATHARINES, ONT.
(Specialty Papers Div.)
Fine paper—180 metric tpd

BEAUHARNOIS, QUE.
(Specialty Papers Div.)
Fine paper—180 metric tpd

DOLBEAU, QUE.
(Newsprint & Kraft Pulp Div.)
Pulp—600 metric tpd chemi-thermomechanical
Newsprint—500 metric tpd

DONNACONA, QUE.
(Newsprint & Kraft Pulp Div.)
Pulp—500 metric tpd thermomechanical
Newsprint and groundwood printing paper—500 metric tpd

LEBEL-sur-QUÉVILLON, QUE.
(Newsprint & Kraft Pulp Div.)
Pulp—720 metric tpd kraft (for market)

WINDSOR, QUE.
(Specialty Papers Div.)
Pulp—850 metric tpd kraft
Fine paper—907 metric tpd (1,000 short)

Packaging Group:

MISSISSAUGA, ONT.
Linerboard—256 metric tpd

RED ROCK, ONT.
Pulp—773 metric tpd kraft; 166 tpd groundwood
Linerboard—651 metric tpd
Newsprint—202 metric tpd

TRENTON, ONT.
Pulp—136 metric tpd semichemical
Corrugating medium—312 metric tpd

Construction Materials, Gypsum products:

SAN LEANDRO, CALIF.
(Domtar Gypsum Inc.)
Chipboard, gypsum linerboard—150 short tpd (136 metric)

VERNON,CALIF.
(Domtar Gypsum Inc. formerly Genstar Gypsum Products Co. mill)
Gypsum paper—150 short tpd (136 metric)

LOCKPORT, N.Y.
(Upson Products Div.)
Gypsum linerboard—170 short tpd (154 metric)

Total production capacity:

PULP	
Kraft	2,676 metric tpd
Groundwood	166 metric tpd
Semichemical	136 metric tpd
TMP	500 metric tpd
CTMP	600 metric tpd
Total	4,078 metric tpd

PAPER AND BOARD	
Newsprint, groundwood printing	1,202 metric tpd
Fine paper	2,023 metric tpd
Linerboard	907 metric tpd
Corrugating medium	312 metric tpd
Gypsum paper/board	426 metric tpd
Total	4,870 metric tpd

Donohue Inc.

801 chemin Saint-Louis
Quebec City, Que. G1S 4W3
Charles-Albert Poissant, chairman/chief executive officer

(Mircor Inc., a holding company owned by Quebecor Inc. and Mirror Group, controls roughly 55% of Donohue's common stock. [Donohue owns 55% of Donohue St-Félicien Inc.; Fletcher Challenge Canada Ltd. owns 45%. Donohue owns 58.1% of Donohue Normick Inc.; Normick Perron Inc. owns 41.9%. At the three-machine mill at Clermont, Que., Donohue owns 51% of Donohue Malbaie Inc.; New York Times Co. owns 49%. In addition, Donohue has two other paper machines at this mill.])

(million C$)

	Net sales	Net earnings
1990	C$611.0	C$29.0
1989	641.5	44.3
1988	648.3	68.7
1987	510.1	44.2
1986	475.6	24.5

Donohue is an eastern Canadian forest products company focused on the production and sale of newsprint, market pulp, and lumber. Donohue Inc.'s expansion efforts during the past fifteen years have included involvement in the construction of a C$280-million pulp mill in 1978 (Donohue St-Félicien), a greenfield newsprint mill in 1982 (Donohue Normick Inc.), a new thermomechanical pulping system and newsprint machine at its Clermont newsprint mill, and a joint-venture BCTMP mill in Matane, Que. As a result, Donohue has some of the most modern, large-scale mills in the Canadian industry.

In 1990, newsprint sales were C$276 million. About 65% of Donohue's newsprint sales typically go to several major publishers with which the company has long-term supply contracts. In 1990, Donohue sold 75% of its newsprint to the U.S., 10% to Canada, 13% to Europe, and 2% elsewhere.

Market pulp sales reached C$233 million in 1990, and output was 165,000 metric tons.

At the end of 1990, Donohue signed an agreement with Cascades Inc. and James Maclaren Industries for 25% participation (C$3.5-million investment) in a 94,000-tpy deinking mill to be located in Cap-de-la-Madeleine, Que. If the project obtains the financing required, Donohue would invest the C$3.5 million pledged and commit to purchase 39,000 tpy when the mill becomes operational.

In 1990, capital expenditures of C$23 million were allocated for the maintenance and improvement of Donohue's facilities. The company expects to spend approximately C$55 million in 1991. Of this amount, C$22 million will be spent on regular capital expenditures, C$23 million for the construction of a chlorine dioxide and wrapping facility at the St. Felicien mill, and $6 million at the Amos mill for the secondary treatment of effluents. The remainder will be invested in the Cap-de-la-Madeleine deinking mill.

In late 1990, a new C$290-million, 209,000-metric-tpy bleached chemi-thermomechanical pulp mill at Matane, Que., started up. Donohue Matane Inc., a company that is held 50% by Donohue and 50% by Rexfor, a Quebec crown corporation, built the mill and intended to manage the facility. Weak market conditions for CTMP, however, caused the pulp mill to close indefinitely in September 1991. Donohue Matane announced that the facility could reopen if BCTMP prices recover significantly.

Production facilities:

AMOS, QUE.
(Donohue Normick Inc.)
Pulp—535 metric tpd thermomechanical
Newsprint—480 metric tpd

CLERMONT, QUE.
Pulp—1,100 metric tpd thermomechanical
Newsprint—980 metric tpd

MATANE, QUE.
(Donohue Matane Inc.—joint venture with Rexfor)
(Closed indefinitely 9/91)
Pulp—550 metric tpd bleached chemi-thermomechanical

ST-FÉLICIEN, QUE.
(Donohue St-Félicien)
Pulp—880 metric tpd bleached kraft for market (Donohue's share—484 tpd)

Total production capacity:
(Does not include Donohue Matane)

PULP	
TMP	1,635 metric tpd
Kraft	880 metric tpd
Total	2,515 metric tpd
PAPER	
Newsprint	1,460 metric tpd

Eddy Paper Co. Ltd.

1600 Scott St.
Ottawa, Ont. K1Y 8N8
E.F. Boswell, president/chief executive officer

(A wholly owned subsidiary of George Weston Ltd., Eddy Paper in turn owns E.B. Eddy Forest Products Ltd.)

(million C$)

	Net sales	Operating income
1990	C$527.7	C$30.0
1989	634.9	87.0
1988	788.3	93.0
1987	659.2	68.0
1986	584.4	56.0

Eddy Paper Co. Ltd. is a producer of fine paper, tissue, specialty papers, and market pulp. It transfers market pulp from its 340,000-metric-tpy Espanola, Ont., mill to its nonintegrated paper mills at Ottawa, Ont., Hull, Que., and Port Huron, Mich. About 190,000 tons of market pulp are sold on the outside.

About 90% of total sales are derived from the pulp and paper sector. In 1990, Eddy produced 256,072 short tons of paper and 337,033 metric tons of pulp.

Capital expenditures in 1990 were C$58 million, and the company expected to spend C$45 million in 1991.

In 1990, Eddy rebuilt a fine papers machine at its largest facility, in Espanola in order to expand and improve the mill's product line. Then, in an attempt to increase cost efficiency in summer 1991, the company closed down three of its six specialty fine paper machines at the Hull Div. and a third machine in Ottawa for a total uncoated free-sheet capacity reduction of more than 50,000 tpy.

Eddy controls 1.7 million acres of Crown woodlands in Canada.

Production facilities:

ESPANOLA, ONT.
(E.B. Eddy Forest Products Ltd.)
Pulp—955 metric tpd kraft (545 tpd for market)
Fine and specialty paper—175 short tpd

OTTAWA, ONT.
(E.B. Eddy Forest Products Ltd.)
Fine and specialty paper—110 short tpd

HULL, QUE.
(E.B. Eddy Forest Products Ltd.)
Fine and specialty paper—220 short tpd

PORT HURON, MICH.
(E.B. Eddy Paper Inc.)
Specialty paper—280 short tpd

Total production capacity:

PULP	955 metric tpd
PAPER	785 short tpd

Eurocan Pulp & Paper Co.

Box 1400
Kitimat, B.C. V8C 2H1
Kari Suopanki, president

(Eurocan is a joint venture between Enso Forest Products Ltd. [division of Enso-Gutzeit Oy, Finland] and West Fraser Timber Co. Ltd.)

(C$ million)

	Net sales
1990	C$304.6
1989	299.6
1988	336.0
1987	318.0
1986	283.0

Since starting up in 1971 under the ownership of three Finnish companies, this mill in interior British Columbia has had an uneven financial performance due to market fluctuations for its principal products—linerboard and kraft paper. The company has undergone several ownership changes, the most recent when West Fraser Timber Co. Ltd. bought 50% control in 1981-84.

Pulp, paper, and paperboard comprise 58% of all Eurocan's sales. In 1990, the company produced 341,000 metric tons of paper and paperboard.

Eurocan spent C$14.1 million in capital expenditures in 1990 but expects to reduce that figure to C$11.4 million in 1991. Eurocan has budgeted nearly C$13.4 for a refiner replacement program and various modifications and upgrades on existing machinery at its Kitimat, B.C., mill.

Production facilities:

KITIMAT, B.C.
Pulp—1,000 metric tpd kraft
Groundwood CMP—320 metric tpd
Linerboard—1,000 metric tpd
Kraft paper—320 metric tpd

Federal Paper Board Co. Inc.

75 Chestnut Ridge Rd.
Montvale, N.J. 07645
John R. Kennedy Jr., president/chief executive officer

(million $)

	Net sales	Net earnings
1990	$1,365.7	$118.2
1989	1,310.1	205.5
1988	1,116.1	143.3
1987	1,025.7	65.8*
1986	948.6	18.4*

* After extraordinary charges of $8.2 million in 1987 and $15.1 million in 1986.

Federal has three segments: Paper, Paperboard, and Pulp (bleached paperboard and pulp, recycled paperboard, uncoated paper), Wood Products (sheeting plants, woodlands, and lumber), and Converting Operations (packaging and printing and cup operations).

In April 1989, Federal acquired Thomas Tait & Sons Ltd. of Inverurie, Scotland, for $56.2 million. Tait, which markets its output in the U.K. and the European continent, introduced the company to uncoated free-sheet production. The company acquired Imperial Cup Corp. in October 1989, providing an entry into a new and growing market and an outlet for bleached paperboard produced at Federal's own mills. In September 1990, Federal bought Continental Bondware, a major producer of paper cups and disposable food service products.

In 1990, Federal produced 674,109 tons of bleached paperboard, 559,103 tons of market pulp, and 167,981 tons of recycled paperboard. In addition, wholly owned subsidiary Thomas Tait & Sons Ltd. produced 133,000 tons of uncoated free-sheet.

Net sales to unaffiliated customers were: recycled and bleached paperboard, $528 million; pulp, $258 million; paper, $137 million; converting operations, $333 million; and wood products, $109 million.

Total capital expenditures in 1990 were $509.3 million, $458.6 million of which went toward paper, paperboard, and pulp operations. Federal expected to spend significantly less in 1991.

The company is near completion of Phase II of its $530-million capital investment program at the Augusta, Ga., bleached paperboard mill. Phase II includes a paperboard capacity expansion to 1,860 tpd and rebuilds of two of the mill's three paperboard machines. One machine rebuild is complete, and the other is to be rebuilt in fourth-quarter 1991. Phase III was expected to focus on the installation of a fourth paperboard machine, but Federal will determine late in 1991 whether to add a new uncoated free-sheet machine instead.

Federal owns 561,391 acres of timberland in the U.S., and it leases an additional 129,131 acres.

Production facilities:

VERSAILLES, CONN.
(Sprague Div.)
Recycled board—573 tpd

AUGUSTA, GA.
Pulp—1,374 tpd bleached kraft (117 tpd for market)
Bleached paperboard—1,544 tpd

RIEGELWOOD, N.C.
Pulp—2,160 tpd bleached kraft (1,411 tpd for market)
Bleached paperboard—819 tpd

Total production capacity:

PULP	3,534 tpd (1,528 for market)
PAPERBOARD	
Bleached paperboard	2,363 tpd
Recycled paperboard	573 tpd
Total	2,936 tpd

Fletcher Challenge Canada Ltd.

700 West Georgia St.
Box 10058, Pacific Centre
Vancouver, B.C. V7Y 1J7
Ian Donald, president/chief executive officer

(FCC owns 100% of Blandin Paper Co., 45% of Donohue St-Felicien Inc., and 50% of Finlay Forest Industries Ltd. In late 1989, FCC sold its 22.7% stake in Western Forest Products Ltd., the parent of Western Pulp Ltd. Partnership of British Columbia, to Doman Industries Inc.)

(million C$)

	Net sales	Net earnings
1990	C$1,160.4	C$54.9
1989	1,402.8	96.2
1988	1,471.5	182.2
1987	1,400.4	140.2
1986	1,100.1	40.2

In September 1988, shareholders of British Columbia Forest Products Ltd. approved a plan by parent company Fletcher Challenge Ltd. of New Zealand (FC) to jointly operate its Canadian holdings, creating a new company called Fletcher Challenge Canada Ltd. (FCC), based in Vancouver, B.C. FCC accomplished this without having to buy out BCFP's minority shareholders.

Under the plan, BCFP and Crown Forest Industries Ltd. are run by the new company, essentially merging the two operations, although FC owns just 72% of BCFP. To accomplish this, FC awarded BCFP a contract to manage its wholly owned CFI operations for a fee. The merger enabled FCC to combine functions such as marketing, accounting, and administration, and to concentrate on expansions and modernizations. Capital spending in 1990 was C$248 million, down from C$465 million in 1989. Spending in 1991 was expected to to be reduced to C$243 million.

Production in 1990 for paper and paperboard reached 708,000 metric tons. Pulp production was 324,000 metric tons. Sixty-two percent of the company's sales were derived from pulp, paper/board, and converted products.

In June 1990, Blandin Wood Products Co. sold its oriented strand board mill in Grand Rapids, Minn. In September 1990, Fletcher announced its intention to sell its plywood plant in Delta, B.C.

Also, Fletcher is considering sharing ownership of its Crofton, B.C., mill or selling its 45% stake in the Quebec-based Donohue St. Felicien Inc. mill.

The Campbell River, B.C., mill's C$29-million upgrade of the No. 2 newsprint machine was completed in May 1991, and recovery boiler controls are expected to be installed in 1992. The Crofton mill has undertaken the modernization of its kraft pulp mill in an attempt to reduce costs and increase capacity by 75,000 tpy.

Production facilities:

CAMPBELL RIVER, B.C.
(Elk Falls Mill of Crown Forest Industries—owned by Fletcher Canada New Zealand)
Pulp—1,027 metric tpd kraft (505 tpd bleached for market); 1,187 tpd thermomechanical
Newsprint—1,389 metric tpd
Kraft specialties —87 metric tpd
Linerboard—153 metric tpd

CROFTON, B.C.
(Crofton Pulp & Paper Div.)
Pulp—1,000 metric tpd kraft (800 tpd for market); 575 metric tpd thermomechanical; 650 metric tpd groundwood
Newsprint and specialty paper—1,400 metric tpd

MACKENZIE, B.C.
(Mackenzie Div.)
Pulp—600 metric tpd kraft (for market)

MACKENZIE, B.C.
(Finlay Forest Industries Ltd.—joint venture with Royal Bank of Canada)
Pulp—450 metric tpd groundwood
Newsprint—600 metric tpd

ST-FELICIEN, QUE.
(Donohue St-Felicien Inc.-45% owned; Donohue owns 55%)
Pulp—880 metric tpd bleached kraft (for market)
(FCC's share: 396 tpd)

GRAND RAPIDS, MINN.
(Blandin Paper Co.)
Pulp—550 short tpd (499 metric) mechanical
Coated groundwood—825 short tpd (748 metric)

Total production capacity:

PULP	
Kraft	3,507 metric tpd
TMP	1,762 metric tpd
Mechanical	499 metric tpd
Groundwood	1,100 metric tpd
Total	6,868 metric tpd

PAPER AND BOARD	
Newsprint and specialty	3,389 metric tpd
Kraft specialties	87 metric tpd
Linerboard	153 metric tpd
Coated groundwood	748 metric tpd
Total	4,377 metric tpd

Fort Howard Corp.

1919 S. Broadway
Green Bay, Wis. 54304-9191
Donald DeMeuse, chairman/chief executive officer

(million $)

	Net sales	Net earnings
1990	$1,151.0	$-106.0
1989	1,053.6	-239.3
1988	n.a.	n.a.
1987	1,757.7	157.7
1986	1,549.3	146.3

Fort Howard is the largest U.S. producer of tissue products sold on the commercial and industrial market. It commands about a 25% share of the U.S. commercial and industrial market.

Fort Howard went private in a $3.57-billion leveraged buyout in August 1988. The resulting alterations in financial structure and purchase accounting rendered the figures not directly comparable to previous annual data. In an effort to raise cash to paydown debt following the LBO, Fort Howard effectively sold a 50.1% stake in its U.S. and Canadian cup businesses for $532 million in September 1989. The operations sold included the former Maryland Cup Corp., which Fort Howard bought in 1983 for $536.2 million, and Lily-Tulip Inc., which was purchased in 1986 for $326 million.

In 1991, the company installed a fourth Beloit recycled-tissue machine at its greenfield mill in Rincon, Ga., at a cost of $125 million. This increased mill capacity by 30%. In early 1993, a Beloit 271-in. tissue machine is scheduled to be installed at the mill in Green Bay, Wis., increasing production capacity by 20%. Finally, the mill in Muskogee, Okla., has not yet set a date for the installation of a new tissue machine, but its new alkaline peroxide plant is slated for completion by fourth-quarter 1991.

Production facilities:

(Fort Howard does not release capacity data; figures below are estimates.)

RINCON, GA.
(Savannah River Mill)
Tissue, towels, napkins—957 tpd

MUSKOGEE, OKLA.
Tissue, towels, napkins—957 tpd

GREEN BAY, WIS.
Tissue, towels, napkins—985 tpd

Total production capacity:

PAPER	
Tissue, towels, napkin	2,899 tpd

Garden State Paper Co. Inc.

411 East Franklin St.
Richmond, Va. 23219
Dr. James L. Burke, president

(A wholly owned subsidiary of Media General Inc., which also has a 33% interest in Southeast Paper Manufacturing Co.)

(million $)
Media General Inc's newsprint segment

	Revenue	Operating profit
1990	$132.9	$21.1
1989	131.3	18.2
1988	216.1	47.6
1987	194.0	38.1
1986	164.6	17.4

Garden State operates a recycled newsprint mill using 100% old news as its fiber source. In 1990, the company shipped 227,000 tons to about 70 customers, primarily daily newspapers within a 220-mile radius of the mill in Garfield, N.J.

Garden State's newsprint mill has two paper machines with a combined capacity of 230,000 tpy. This facility has been continually upgraded to improve quality and maximize cost efficiency. In June 1990, Media General, Inc. announced it would seek buyers for Garden State in order to focus its attention on newspaper, cable, and television operations. In October, with no attractive offers to entertain and demand for recycled newsprint improving, Media General took Garden State off the market.

Production facilities:

GARFIELD, N.J.
Pulp—700 tpd deinked
Newsprint—615 tpd

Total production capacity:

PULP	700 tpd
PAPER	615 tpd

Gaylord Container Corp.

500 Lake Cook Rd., Suite 400
Deerfield, Ill. 60015
Marvin A. Pomerantz, chairman/chief executive officer

(million $)

	Net sales	Net earnings
1990	$718.3	-$23.0
1989	746.0	39.4
1988	671.2	41.9
1987*	437.8	19.3

(fiscal year ends Sept. 30.)
* For the ten-month period between November 1986 and September 1987.

Gaylord Container is a major national manufacturer and distributor of brown paper and packaging products. The company serves its customers through a network of three paper mills, 26 converting plants, and marketing operations throughout the U.S.

Gaylord initially consisted of Mid-America Packaging and three mills formerly owned by Crown Zellerbach Corp. Early in 1988, Gaylord acquired assets of the container products division of Louisiana-Pacific Corp.'s Fibreboard Corp. subsidiary. In mid-1988, the company was recapitalized and became a public company.

As containerboard markets began to degenerate, Gaylord's fiscal health followed suit. In fiscal 1990 (year end is Sept. 30), the company lost about 74,000 tons of potential production due to downtime and disruptions and reported a net deficit of $23 million.

For the full fiscal year, Gaylord produced 935,100 tons of containerboard and 251,800 tons of unbleached kraft paper. The company also shipped 10.2 billion ft^2 of corrugated products and 179.4 million multiwall bags.

In addition, fiscal 1990 marked the end of Gaylord's three-year, $300-million capital investment program designed to increase mill capacity and enhance product quality.

Total capital expenditures in 1990 came to $173 million, including $60 million spent to expand and enhance manufacturing capabilities at the company's converting facilities.

In early 1991, Gaylord announced that it would "temporarily idle" production on the two containerboard machines at the East Mill in Antioch, Calif. The company has since indicated that it may sell all or part of East Mill's assets.

Production facilities:

PINE BLUFF, ARK.
Pulp—350 tpd kraft
Unbleached kraft paper—450 tpd bag, sack

ANTIOCH , CALIF.
Recycled linerboard—1,000 tpd

BOGALUSA, LA.
Pulp—1,350 tpd kraft; 300 tpd semichemical
Containerboard and unbleached kraft paper—2,600 tpd

Total production capacity:

PULP	
Kraft	1,700 tpd
Semichemical	300 tpd
Total	2,000 tpd
PAPER AND BOARD	
Containerboard and unbleached	3,050 tpd
Recycled linerboard	1,000 tpd
Total	4,050 tpd

Georgia-Pacific Corp.

133 Peachtree St. N.E.
Atlanta, Ga. 30303
T. Marshall Hahn Jr., chairman/chief executive officer

(million $)

	Net sales	Net earnings
1990	$12,665	$335
1989	10,171	661
1988	9,509	467
1987	8,603	458
1986	7,223	296

Georgia-Pacific, one of the largest U.S. producers of building materials, has modified its strategy to achieve a better balance between its paper and building products sectors and to stabilize performance in business cycles, culminating in the $3.7 billion hostile takeover of Great Northern Nekoosa Corp. in 1990. As a result, the majority of G-P's revenue is derived from paper-related sales.

The company has since concentrated on reducing its debt and has made a number of major divestments. In February 1991, G-P sold its Valdosta, Ga., and Tomahawk, Wis., mills for $727 million in a complex transaction involving GE Capital and Packaging Corp. of America. In October 1991, G-P agreed to sell an 80% interest in Great Northern Paper to Bowater for $300 million. The joint venture agreement gives Bowater the right to purchase G-P's remaining 20% interest after June 30, 1992, and also gives G-P the right to require Bowater to do so.

Sales of pulp and paper represented 53% of G-P's 1990 total sales ($6.702 billion). Of this amount, containerboard and packaging accounted for 19%, or $2.4 billion; communication papers, 11% ($1.36 billion); tissue, 6% ($719 million); market pulp, 6% ($779 million); groundwood papers, 2% ($305 million); and other grades, 9% ($1.1 billion).

In 1990, market pulp output was 1,667,000 short tons, and paper/board production reached 6,901,000 tons.

Capital expenditures, excluding acquisitions, in 1990 reached $866 million, up $406 million from 1989. The company expects to spend $600 to $650 million overall in 1991 and further reduce expenditures in 1992 to $500 to $550 million.

The company spent about $500 million at its mill in Ashdown, Ark., to install a new 325,000-tpy, 4,000-fpm uncoated free-sheet paper machine.

Prior to the Bowater transaction, G-P owned 8,203,000 acres of timberland in North America and controlled an additional 1 million acres.

Production facilities:

ASHDOWN, ARK.
Pulp—1,350 tpd kraft
Uncoated free-sheet—1,350 tpd

CROSSETT, ARK.
Pulp—1,500 tpd kraft; 126 tpd deinked
Printing paper—490 tpd
Tissue and towel—440 tpd
Solid bleached board—436 tpd

PALATKA, FLA.
Pulp—1,200 tpd kraft; 19 tpd deinked
Kraft paper—680 tpd
Tissue/toweling—515 tpd

BRUNSWICK, GA.
Pulp—2,000 tpd kraft (1,450 for market)
Bleached board—530 tpd

CEDAR SPRINGS, GA.
Pulp—2,300 tpd kraft; 525 tpd semichemical
Linerboard—2,395 tpd
Corrugating medium—630 tpd

TAYLORVILLE, ILL.
Printing/writing paper—100 tpd

GARY, IND.
Pulp—80 tpd deinked
Industrial toweling—77 tpd

PORT HUDSON (Zachary), LA.
Pulp—1,850 tpd bleached kraft
Printing paper—1,500 tpd

EAST MILLINOCKET, MAINE
Pulp—725 tpd groundwood
Newsprint—920 tpd

MILLINOCKET, MAINE
Pulp—555 tpd sulfite; 855 tpd groundwood
Printing Papers—1,125 tpd

WOODLAND, MAINE
Pulp—840 tpd kraft; 240 tpd groundwood
Printing paper—313 tpd

KALAMAZOO, MICH.
Pulp—200 tpd deinked
Printing paper—400 tpd

MONTICELLO, MISS.
Pulp—2,500 tpd kraft; 513 tpd deinked
Kraft linerboard—2,675 tpd

NEW AUGUSTA, MISS
Pulp—1,400 tpd kraft

DELAIR, N.J.
Pulp—230 tpd deinked
Gypsum paperboard—200 tpd

PLATTSBURGH, N.Y.
Pulp—120 tpd semichemical; 27 tpd deinked
Tissue and towel—260 tpd

PRYOR, OKLA.
Pulp—130 tpd deinked
Gypsum paperboard—235 tpd

TOLEDO, ORE.
Pulp—1,150 tpd kraft; 320 tpd semichemical
Kraft paper—290 tpd
Kraft linerboard—990 tpd
Corrugating medium—475 tpd

BIG ISLAND, VA.
Pulp—600 tpd semichemical
Corrugating medium—815 tpd

NEKOOSA, WIS.
Pulp—335 tpd kraft
Uncoated free-sheet—575 tpd

PORT EDWARDS, WIS.
Pulp—235 tpd kraft
Uncoated free-sheet—440 tpd

BELLINGHAM, WASH.
Pulp—650 tpd bleached sulfite; 80 tpd semichemical
Tissue/toweling—250 tpd

THOROLD, ONT.
(Beaver Wood Fibre Co.)
Pulp—315 metric tpd deinked (347 short tpd)
Gypsum paperboard—350 metric tpd (385 short tpd)

Total production capacity:

PULP	
Kraft	16,660 tpd
Semichemical	1,645 tpd
Sulfite	1,205 tpd
Deinked	1,692 tpd
Groundwood	240 tpd
Total	21,444 tpd
PAPER	
Printing/writing	3,928 tpd
Tissue/toweling	1,542 tpd
Kraft paper	3,470 tpd
Uncoated free-sheet	2,365
Industrial toweling	77 tpd
Newsprint	920 tpd
Total	12,302 tpd
PAPERBOARD	
Kraft linerboard	6,060 tpd
Bleached board	966 tpd
Semichemical medium	520 tpd
Gypsum paperboard	820 tpd
Corrugating medium	1,920 tpd
Total	10,286 tpd
TOTAL PAPER AND BOARD	22,588 tpd

Gilman Paper Co.

1000 Osborne St.
St. Marys, Ga., 31558
Howard Gilman, chairman/chief executive officer, William H. Davis, president/chief operating officer

(million $)

	Net sales
1990	$434
1989	395
1988	362

Net sales for this privately held company were $434 million. Approximately 74% of 1990 sales came from pulp, paper, and board products. Production in 1990 was 413,086 short tons of paper and paperboard and 425,990 tons of pulp. Earnings information is not available.

The company's current strategy is to upgrade facilities and switch from brown papers to bleached papers. Total capital expenditures in 1990 were $13 million. Gilman budgeted $17 million for capital expenditures in 1991. Most capital expenditures over the next few years will be for pollution-related items.

The company owns 178,276 acres of timberland in the U.S., and it controls 48,805 acres.

Production facilities:

ST. MARYS, GA.
Pulp—1,200 tpd kraft (900 tpd bleached, 300 tpd unbleached)
Paper & board—1,200 tpd (half paper, half board; bleached and unbleached; coated and uncoated)

Total production capacity:

PULP	1,200 tpd
PAPER & BOARD	1,200 tpd

P.H. Glatfelter Co.

228 Main St.
Spring Grove, Pa. 17362
T.C. Norris, chairman/president/chief executive officer

(Glatfelter Pulp Wood Co. is a wholly owned subsidiary.)

(million $)

	Net sales	Net earnings
1990	$625.4	$88.3
1989	598.8	92.9
1988	569.3	82.2
1987	423.7	55.0
1986	284.8	41.5

Glatfelter manufactures printing/writing papers, tobacco, and other specialty papers. The company's strategy is to serve niche markets with high-value products in order to avoid more cyclical markets and to emphasize customer service.

The mill at Spring Grove, Pa., is integrated, producing a substantial part of its pulp requirements from wood. The Pisgah Forest, N.C., mill produces flax fiber pulp used to manufacture most of its tobacco industry products and uses purchased virgin woodpulp to make nearly all of Ecusta's printing and other specialty papers. The Neenah, Wis., mill recycles wastepaper for its principal raw material. All company sales are derived from paper and paperboard.

In 1990, Glatfelter produced 554,000 tons of paper/board and 312,000 tons of pulp.

Capital expenditures in 1990 were $35.4 million, and the company expected to spend $89.5 million in 1991.

In 1990, Glatfelter spent $15.5 million at the mill in Spring Grove to rebuild an existing supercalender and install a second one. The project increased coated paper production by 47 tpd and decreased uncoated production by 42 tpd. The company has budgeted an additional $125 million to modernize the mill to meet federal environmental regulations.

Company timberland, managed by Glatfelter Pulp Wood Co., comprise 107,000 acres.

Production facilities:

PISGAH FOREST, N.C.
(Formerly Ecusta Corp. mill)
Pulp—100 tpd flax
Cigarette and thin—250 tpd

SPRING GROVE, PA.
Pulp—580 tpd bleached kraft
Uncoated free-sheet—700 tpd
Coated free-sheet—120 tpd

NEENAH, WIS.
(Bergstrom Paper Div.)
Pulp—250 tpd bleached deinked
Printing/writing—430 tpd

Total production capacity:

PULP	
Kraft	580 tpd
Deinked	250 tpd
Flax	100 tpd
Total	930 tpd
PAPER	
Printing/writing	1,250 tpd
Cigarette and thin	250 tpd
Total	1,500 tpd

Green Bay Packaging Inc.

1700 North Webster Court
Green Bay, Wis. 54307-9017
James F. Kress, president/chief executive officer

Financial data not available.

Green Bay is a diversified, privately owned company with interests in containerboard, converting, lumber, and machinery.

Linerboard output at Arkansas Kraft Corp. in 1990 was 337,960 short tons, which included 119,549 of mottled white. The mill was scheduled to begin production of White Top Liner by mid-1991. The Green Bay mill produced 149,702 tons of medium in 1990. In February 1991, the mill converted to 100% recycled linerboard production. It is expected to average 550 tpd in 1991, increasing production to 700 tpd by early 1992.

The company owns 195,000 acres of timberland in the U.S.

Production facilities:

MORRILTON, ARK.
(Arkansas Kraft mill)
Pulp—800 tpd unbleached kraft
Kraft linerboard—1,150 tpd (includes 450 tpd mottled white)

GREEN BAY, WIS.
(Green Bay mill)
Recycled (100%) linerboard—550 tpd

Total production capacity:

PULP	
Unbleached kraft	800 tpd
Total	800 tpd
PAPERBOARD	
Kraft linerboard	1,150 tpd
Recycled linerboard	550 tpd
Total	1,700 tpd

Gulf States Paper Corp.

Box 3199
Tuscaloosa, Ala. 35404
J.W. Warner, chairman/chief executive officer

Financial data not available.

Gulf States primary business operations are comprised of pulp and paper, packaging, and wood products. The company announced in November 1989 that it planned to double the pulping capacity of its Demopolis, Ala., mill, from 750 tpd to 1,500 tpd by mid-1993. Improvements will also be made to the wood handling and paperboard production areas of the mill. This increase would serve as a prelude to the installation of an additional board machine at the mill. Market pulp output will increase from about 120 tpd to over 800 tpd until a new board machine is started up. The $250-million investment for Phase One of the expansion, which will take four years to complete, is the largest in the company's 105-year history. Phase Two of the project, the new board machine, is not expected to begin until the mid-1990s.

The company owns or controls approximately 400,000 acres of U.S. timberland.

Production facilities:

DEMOPOLIS, ALA.
Pulp—750 tpd bleached kraft (75 tpd deinked and 125 tpd for market)
Paperboard—660 tpd bleached coated paperboard

Total production capacity:

PULP	750 tpd
PAPERBOARD	660 tpd

Interstate Resources Inc.

1800 N. Kent St., Suite 1200
Rosslyn, Va. 22209
Fares Korkmaz, acting chief executive officer

Financial data not available.

One hundred percent of Interstate's sales are derived from pulp, paper/board, and converted products. Interstate sells on the open market and supplies Interstate container plants in Reading, Pa., and Lowell, Mass.

Total capital expenditures in 1990 were $19 million. The company expected to reduce spending to $14 million in 1991, 70% of which will be allocated to pulp and papermaking facilities. The company produced 285,000 tons of paper and paperboard in 1990.

Interstate has initiated a TRS compliance project at its mill in Riceboro, Ga., which was scheduled for completion in June 1991. In 1990, the mill began producing 36-lb kraft linerboard.

Production facilities:

RICEBORO, GA.
(Interstate Paper Corp.)
Pulp—600 tpd kraft
Linerboard—760 tpd

READING, PA.
(Interstate Intercorr Corp.)
Recycled corrugating medium—100 tpd

Total production capacity:

PULP	600 tpd
PAPERBOARD	860 tpd

International Paper Co.

2 Manhattanville Rd.
Purchase, N.Y. 10577
John A. Georges, chairman/chief executive officer

(IP is a joint-venture partner in Grays Harbor Paper Co.)

(million $)

	Net sales	Net earnings
1990	$12,960	$569*
1989	11,378	864
1988	9,533	754
1987	7,763	407
1986	5,500	305

* Includes $137-million business improvement change

International Paper is one of the largest paper companies in the world, with over 30 pulp and paper mills in the U.S. and overseas. Among the grades produced are uncoated free-sheet, coated papers, bristols, paper and specialty pulp, containerboard, bleached board, and kraft packaging.

IP enters the 1990s a strong, well-positioned company after completing a major restructuring program over the preceding ten years. The company spent $8 billion rebuilding its mill system to improve quality and efficiency, increase capacity, and lower costs. IP also realigned its business operations by selling its Canadian holdings in 1981 and withdrawing from the newsprint business by 1985.

Sales by the pulp and paper segment in 1990 climbed to $4.7 billion, compared with $3.7 billion in 1989. Paperboard and packaging sales rose to $3.5 billion, compared with $3.4 billion in 1989.

In 1990, output of paper and paperboard, including overseas operations, was as follows: white papers and bristols, 3,065,000 tons; market pulp, 1,101,000 tons; coated papers, 1,059,000 tons; containerboard, 2,122,000 tons; bleached packaging board, 924,000 tons; industrial papers, 610,000 tons; and industrial/consumer packaging, 2,398,000 tons.

Capital expenditures for 1990 were $1.3 billion. IP plans to spend about $1.1 billion on capital projects in 1991.

The company continues to be active on the acquisition front. In January 1991, the Industrial Packaging Group acquired 50% ownership in Papeteries Etienne's 100,000-tpy linerboard and containerboard mill for $105 million.

Recently, IP has made a concerted effort to expand its distribution business. In 1990, IP purchased Dixon Paper Co. for an estimated $70 to $80 million. In April 1991, the company enhanced its coverage of the mid-Atlantic and southeastern states with the acquisition of Dillard Paper Co. Four months later, IP finalized a deal to purchase Minneapolis, Minn.-based Leslie Paper for $34 million.

IP controls 6.3 million acres of timberlands, 6.1 million of which are held through its majority ownership of I.P. Timberlands Ltd.

Production facilities:
(IP does not release capacity figures; the following are from published sources or are estimates.)

International Paper Co.

MOBILE, ALA.
Pulp—1,035 tpd kraft
Uncoated free-sheet—1,200 tpd
Packaging/industrial converting paper—239 tpd

CAMDEN, ARK.
Pulp—723 tpd
Packaging/industrial converting paper—732 tpd

PINE BLUFF, ARK.
Pulp—1,300 tpd bleached and unbleached kraft
Publication paper—565 tpd
Solid bleached board—1,150 tpd

BASTROP, LA.
Pulp—1,200 tpd bleached kraft
Printing/writing paper—500 tpd
Solid bleached board—620 tpd

MANSFIELD, LA.
Pulp—2,240 tpd unbleached kraft
Linerboard—1,450 tpd
Corrugating medium—1,000 tpd

PINEVILLE, LA.
Pulp—975 tpd unbleached kraft
Unbleached kraft board—985 tpd

JAY, MAINE
Pulp—1,200 tpd bleached kraft; 245 tpd groundwood
Printing/writing paper—1,350 tpd

MOSS POINT, MISS.
Pulp—661 tpd kraft
Printing/writing paper—150 tpd
Packaging/industrial converting paper and solid bleached board—760 tpd

NATCHEZ, MISS.
Pulp—600 tpd bleached kraft; 600 dissolving (for market)

VICKSBURG, MISS.
Pulp—1,200 tpd kraft
Unbleached kraft board—1,500 tpd

CORINTH, N.Y.
Pulp—160 tpd groundwood
Printing/writing paper—525 tpd

TICONDEROGA, N.Y.
Pulp—530 tpd bleached kraft
Printing/writing paper—750 tpd

GARDINER, ORE.
Pulp—600 tpd kraft
Unbleached kraft board—900 tpd

GEORGETOWN, S.C.
Pulp—1,600 tpd bleached kraft (915 for market)
Uncoated free-sheet—370 tpd
Bleached bristol—345 tpd

TEXARKANA, TEXAS
Pulp—1,300 tpd kraft (estimated 500 tpd for market)
Bleached paperboard—1,300 tpd

MERRILL, WIS.
(Former Ward Paper Co. mill of Arvey Corp.)
Pulp—60 tpd deinking
Fine, specialty papers—100 tpd

Hammermill Paper Div.

SELMA, ALA.
(Riverdale Plant)
Pulp—1,375 tpd bleached kraft (850 tpd for market)
Uncoated free-sheet—525 tpd

WESTFIELD, MASS.
(Strathmore Paper Co., including facilities at Westfield, Millers Falls, Turners Falls, and Woronoco, Mass.)
Printing/writing paper—190 tpd

OSWEGO, N.Y.
Printing/writing paper—217 tpd

HAMILTON, OHIO
(Beckett Paper Co.)
Printing/writing paper—530 tpd

ERIE, PA.
Pulp—680 tpd Neutracel II bleached alkaline (for market)
Printing/writing paper—600 tpd

LOCK HAVEN, PA.
Printing/writing paper—725 tpd

HOQUIAM, WASH.
(Grays Harbor Paper Co., jointly owned)
Printing/writing, related paper—310 tpd

DE PERE, WIS.
(Nicolet Div. of Thilmany Pulp & Paper—former Philip Morris mill)
Paper—100 tpd glassine, greaseproof, release, sanitary waxing

KAUKAUNA, WIS.
(Thilmany Pulp & Paper Co.)
Pulp—420 tpd bleached and unbleached kraft
Packaging/industrial converting paper—550 tpd

Total production capacity:

PULP	
Kraft	16,959 tpd
Groundwood	405 tpd
Dissolving	600 tpd
Neutracel	680 tpd
Deinking	60 tpd
Total	18,704 tpd

PAPER	
Printing/writing	6,412 tpd
Uncoated free-sheet	2,095 tpd
Fine	100 tpd
Specialty	100 tpd
Packaging/industrial converting*	4,051 tpd
Bleached bristols	345 tpd
Total	13,103 tpd

* Includes some solid bleached board

PAPERBOARD	
Bleached paperboard	1,300 tpd
Linerboard	1,450 tpd
Unbleached kraft board	3,385 tpd
Corrugating medium	1,000 tpd
Total	7,135 tpd

TOTAL PAPER AND BOARD
20,238 tpd

Irving Pulp & Paper Ltd.

Box 3007, Station B
Saint John, N.B. E2M 3H1
J.K. Irving, president

Financial data not available.

Following the acquisition of the St. John, N.B., mill from Kimberly-Clark Corp. early in 1988, Irving announced it would install a new 60,000-tpy tissue machine at the mill. The machine was started up in November 1989. In 1990, the company initiated work on a small, new converting plant.

In 1990, members of the Canadian Paper workers Union Local 601 went on strike at Irving Paper Ltd. As a result, one machine was not operational for most of the year.

Production facilities:

SAINT JOHN, N.B.
(Irving Pulp & Paper Ltd.)
Pulp—775 metric tpd bleached and semibleached kraft (for market)

SAINT JOHN, N.B.
(Irving Paper Ltd., formerly Rothesay Paper Ltd.)
Pulp—715 metric tpd groundwood; 300 metric tpd thermomechanical
Newsprint—935 metric tpd

SAINT JOHN, N.B.
(Irving Tissue Co.)
No. 1 crepe wadding machine—44 metric tpd
No. 2 crepe wadding machine—165 metric tpd

ST. GEORGE, N.B.
(Lake Utopia Paper Ltd.)
Corrugating medium—300 metric tpd

Total production capacity:

PULP	
Kraft	775 metric tpd
Groundwood	715 metric tpd
TMP	300 metric tpd
Total	1,790 metric tpd
PAPER AND BOARD	
Newsprint	935 metric tpd
Tissue	209 metric tpd
Corrugating medium	300 metric tpd
Total	1,444 metric tpd

ITT Rayonier Inc.

1177 Summer St.
Stamford, Conn. 06904
Ronald M. Gross, chairman/president/chief executive officer

(ITT Rayonier Inc. is a subsidiary of ITT Corp. ITT Rayonier jointly owns Grays Harbor Paper Co. with International Paper Co., which operates the mill and markets its products.)

(million $)

	Net sales	Net earnings
1990	$1,104.3	$65.8
1989	1,082.2	128.0
1988	1,010.5	61.5
1987	757.3	33.5
1986	669.9	1.2

ITT Rayonier is a major producer of dissolving, paper-grade, and fluff market pulp at three mills (Jesup, Ga., Fernandina Beach, Fla., and Port Angeles, Wash.) Of these, the large, modern Jesup kraft mill is believed to be the most cost-efficient. The Hoquiam, Wash., pulp mill supplies mainly the adjacent Grays Harbor Paper joint-venture mill. The company has suffered recently from soft markets for dissolving pulp, weak pricing, and higher production costs at some mills.

Approximately 60% of total sales—$670 million in 1990—were derived from pulp operations. The company produced 885,000 metric tons of pulp in 1990.

Capacity was 935,000 metric tpy. ITT's 1990 capital expenditures amounted to $80 million. The company expects that figure to increase to $135 million in 1991. Operating income for 1990 was $190 million, $36.4 million less than in 1989.

In recent years, ITT invested $60 million on an environmental upgrade at its mill in Jesup, Ga.

In 1990, ITT weathered a five-month labor strike by 270 members of the Assn. of Western Pulp & Paper Workers. Employees at the mill in Hoquiam struck in opposition to a contract structure that affected the wages and benefits of approximately one-third of the labor force. Throughout the duration of the strike, the mill was operated by management employees, thereby preventing a disruption in production. Strikers returned to work in late-January 1991. In March 1991, mechanics at the mill won a $57-million damage claim against the company as payment for the time they were required to be on call and available for work during the years 1987-90. The company has appealed the ruling.

Most timberland properties are owned or leased by Rayonier Timberlands LP, a publicly held master limited partnership of which ITT Rayonier Inc. and Rayonier Forest Resources Co. are general partners.

Total ITT Rayonier and Rayonier Timberlands LP comprise 1,123,000 acres owned and 138,000 acres controlled.

Production facilities:

FERNANDINA BEACH, FLA.
(Fernandina Div.)
Pulp—400 tpd sulfite (for market)

JESUP, GA.
(Jesup Div.)
Pulp—1,425 tpd bleached kraft (for market)

HOQUIAM, WASH.
(Grays Harbor Div.)
Pulp—325 tpd sulfite

HOQUIAM, WASH.
(Grays Harbor Paper Co.)
(see International Paper Co.)

PORT ANGELES, WASH.
(Port Angeles Div.)
Pulp—410 tpd sulfite (for market)

Total production capacity:
(Does not include Grays Harbor Paper Co.)

PULP	
Sulfite	1,135 tpd
Kraft	1,425 tpd
Total	2,560 tpd

James River Corp.

120 Tredegar St.
Box 2218
Richmond, Va. 23217
Bob Williams, chief executive officer/president

(James River owns 80% of James River-Marathon Ltd. in Canada, and Buchanan Forest Products Ltd. owns 20%.)

(million $)

	Net sales	Net earnings
1990	$3,391*	$10
1990	5,950	222
1989	5,871	255
1988	5,097	209
1987	4,479	169
1986	2,606	95

(Fiscal year ending is April. All years are 52 weeks except 1989, which is 53 weeks)
*35-week period ending Dec. 30, 1990

James River is one of the world's leading producers of pulp, paper, and converted paper and plastic products. The company manufactures and converts products for five major markets: hygienic products, communication papers, disposable food service products, food and consumer packaging, and specialty papers. With its subsidiaries and affiliates, James River encompasses 126 manufacturing facilities, located in 13 countries, with over 38,000 employees in North America and Europe.

JR is in the midst of a restructuring program that will narrow its focus on its more profitable operations. As part of the restructuring, the company plans to sell or close 30 mills and converting plants representing $1.3 billion in sales, or about 20% of total capacity, in the U.S. and U.K. Most of the operations being sold are part of the specialty papers business, including the H.P. Smith division.

In addition, James River has sold its publishing papers mill in West Linn, Ore., as well as its business papers mill in Wiggins, Miss., and its towel and tissue mill in Glens Falls, N.Y. The company will also reduce its interest in the Marathon, Ont., pulp mill from 80% to 50%.

In 1990, James River changed its fiscal year end from April to December. On a recast basis, sales for the 53-week year ending Dec. 30, 1990, were as follows: communication papers, $913 million (16% of total sales); consumer products, $2.4 billion in sales (42%); food/consumer packaging, $1.6 billion (29%); and assets divested/for sale, $725 million (13%).

Total capital expenditures (including acquisitions) were $272.1 million in fiscal 1990.

The company's largest tissue facility, the Naheola pulp and paper mill in Pennington, Ala., is undergoing a $157-million upgrade, which will increase the mill's pulping capacity by about 100,000 tpy. James River has also formed the Naheola Cogeneration Limited Partnership with CRSS Capital Inc. to develop and construct a $300-million cogeneration facility at Pennington.

During 1990, the company delayed a $280-million project intended to double the capacity of its pulp mill in Marathon. A $97-million capacity expansion was initiated at the Kalamazoo, Mich., paperboard mill, as was a $38-million rebuild of a coated groundwood paper machine at the St. Francisville, La., mill.

In 1990, James River pooled its European interests with those of Gruppo Ferruzzi of Italy and Nokia Corp. of Finland to form a joint venture for manufacturing and marketing consumer tissue products in Europe.

James River controls approximately 4.2 million acres of timberland.

Production facilities:
(The following are estimates.)

Communication Papers Business

NEWARK, DEL.
(Curtis Mills Div.)
Cotton papers—24 tpd

ST. FRANCISVILLE, LA.
(Former Crown Zellerbach mill)
Pulp—775 tpd
Uncoated free-sheet—275 tpd
Coated groundwood—700 tpd

ADAMS, MASS.
(Curtis Mills Div.)
Uncoated free-sheet—40 tpd

YPSILANTI, MICH.
(Curtis Mills Div.)
Uncoated free-sheet—50 tpd

BERLIN, N.H.
(Pulp Div.)
Pulp—800 tpd
(Solka Floc operations sold)

GORHAM, N.H.
(Paper Div.)
Uncoated free-sheet—450 tpd
Tissue—150 tpd

GROVETON, N.H.
Uncoated free-sheet—305 tpd

CLATSKANIE, ORE.
(Wauna Mill)
Pulp—1,161 tpd
Tissue—500 tpd
Uncoated free-sheet—300 tpd
Uncoated groundwood—350 tpd

WEST LINN, ORE. (sold)
Pulp—120 tpd
Uncoated groundwood—500 tpd

CAMAS, WASH.
Pulp—1,000 tpd; 450 tpd sulfite
Uncoated free-sheet—1450 tpd

MARATHON, ONT.
(James River-Marathon Ltd.)
Pulp—500 metric tpd (551 short)

Packaging Business

KALAMAZOO, MICH.
Recycled paperboard—500 tpd

Specialty Papers Business

JAY, MAINE (sold)
(James River-Otis Div.)
Coated thin papers—190 tpd

EAST PEPPERELL, MASS. (sold)
(James River-Pepperell Inc.)
Specialty paper—75 tpd

FITCHBURG, MASS. (sold)
(James River-Fitchburg Div.)
Specialty paper—52 tpd

WEST SPRINGFIELD, MASS. (sold)
(Premoid Div.)
Specialty paper—30 tpd

PARCHMENT, MICH.
(KVP Paper Div.)
Uncoated free-sheet—280 tpd
Coated free-sheet—120 tpd

PORT HURON, MICH.
(Dunn Paper Div.)
Thin papers—170 tpd

ROCHESTER, MICH. (sold)
(Filtration Products Div.)
Specialty paper—18 tpd

WIGGINS, MISS. (sold)
(Dunn Paper Div.)
Thin papers—65 tpd

MILFORD, N.J.
(Riegel Custom Products Div.)
Specialty paper—175 tpd

HUGHESVILLE, N.J. (sold)
(Riegel Custom Products Div.)
Specialty papers—38 tpd

WARREN GLEN, N.J. (sold)
(Riegel Packaging Papers Div.)
Specialty papers—75 tpd

BROWNVILLE, N.Y. (sold)
(Premoid Div.)
Specialty paper—38 tpd

RICHMOND, VA. (sold)
(Filtration Products Div.)
Specialty paper—25 tpd

Towel & Tissue Business

PENNINGTON, ALA.
(Naheola Mill)
Pulp—1,100 tpd kraft
Bleached board—620 tpd
Tissue—650 tpd

OLD TOWN, MAINE
Pulp—1,205
Tissue—212 tpd

CARTHAGE, N.Y.
Deinked pulp—139 tpd
Tissue—140 tpd

GOUVERNEUR, N.Y.
(Nonwovens Div.)
Tissue—45 tpd

SOUTH GLENS FALLS, N.Y. (sold)
(Former Crown Zellerbach mill)
Deinked pulp—1130 tpd
Tissue—180 tpd

HALSEY, ORE.
Tissue—265 tpd

ASHLAND, WIS.
Deinked Pulp—65 tpd
Tissue—60 tpd

GREEN BAY, WIS.
Pulp—160 tpd bleached sulfite
Tissue—470 tpd

Total production capacity:
(excluding mills that have been sold)

PULP	
Kraft, groundwood	6,592 tpd
Bleached sulfite	610 tpd
Deinked	204 tpd
Total	7,406 tpd

PAPER AND BOARD	
Tissue	2,492 tpd
Uncoated free-sheet	3,150 tpd
Coated groundwood	700 tpd
Uncoated groundwood	350 tpd
Thin papers	170 tpd
Coated free-sheet	120 tpd
Cotton-fiber papers	24 tpd
Specialty paper	175 tpd
Bleached board	620 tpd
Recycled board	500 tpd
Total	8,301 tpd

Jefferson Smurfit Corp.

(Subsidiary of Jefferson Smurfit Group plc, Ireland)
8182 Maryland Ave.
Jefferson Smurfit Centre
St. Louis, Mo. 63105
Michael W.J. Smurfit, president and chief executive officer

(Jefferson Smurfit Group plc holds 50%. JSC owns 80% of Smurfit Newsprint Corp. [Times Mirror Co., 20%]; 100% of Container Corp. of America; and 50% of the Monroe, Mich., mill [Monroe Paper Co., 50%]. On Dec. 14, 1989, SIBV/MS Holdings Inc.[Holdings] acquired all of the common stock of JSC. The common stock of Holdings is owned equally by the JS Group, the Morgan Stanley Leveraged Equity Fund II, L.P. and other investors [collectively, the MSLEF II Group]. Concurrent with the Holdings acquisition of JSC, the common equity of CCA owned by MSLEF I group was acquired by CCA, thereby making CCA an indirect, wholly owned subsidiary of JSC.)

For financial reporting purposes, CCA's results are consolidated with JSC as of Jan. 1, 1989.

Jefferson Smurfit Corp.
(million $)

	Net sales	Net earnings
1990	$2,910.9	$21.7
1989	2,936.3	35.8
1988	1,255.3	144.5
1987	1,099.5	92.0
1986	944.4	28.0

Container Corp. of America

	Net sales	Net earnings
1988	$1,731.2	$26.6
1987	1,535.5	87.1
1986	1,683.7	-9.0

Jefferson Smurfit Corp. produces recycled paperboard, spiral cores and tubes, and newsprint.

Approximately 85% of JSC/CCA's sales come from pulp, paper/board, and converted products. In 1990, production of paperboard was 3.4 million tons; newsprint, 750,000 tons; and reclaimed and brokered fiber, 4 million tons.

Capital expenditures in 1990 totaled $192 million, and the company expects to spend $143 million in 1991.

In 1990, JSC/CCA acquired a 100% recycled newsprint mill in Pomona, Calif., formerly operated by Media General Inc. Jefferson's Paperboard group completed a major upgrade and expansion of its Jacksonville, Fla., linerboard mill at a cost of approximately $91 million. At the Fernandina Beach, Fla., linerboard mill, the company is rebuilding an idle machine to add 200,000 tpy of new capacity. It is also investing $100 million in its Brewton, Ala., mill.

The company has also shown an interest in building a greenfield recycled newsprint mill in New York state.

JSC/CCA is about the third largest producer of corrugated containers in the U.S.

JSC/CCA owns or leases 746,000 acres of timberland and leases an additional 222,000 in the U.S.

Production facilities:

JACKSONVILLE, FLA.
Pulp—1,000 tpd unbleached kraft
Kraft linerboard—1,100 tpd

CEDARTOWN, GA.
Tube stock—60 tpd

ALTON, ILL.
Recycled corrugating medium—625 tpd

LAFAYETTE, IND.
Tube stock, chipboard—125 tpd

MONROE, MICH.
Tube stock, chipboard—130 tpd

MONROE, MICH.
(Jointly owned with Monroe Paper Co.)
Recycled paperboard—200 tpd (JSC's share: 100 tpd)

LOCKLAND, OHIO
Recycled boxboard—290 tpd

MIDDLETOWN, OHIO
Recycled boxboard—325 tpd

NEWBERG, ORE.
(Smurfit Newsprint Co.)
Pulp—460 tpd refiner mechanical; 605 tpd deinked; 30 tpd semibleached kraft
Newsprint—1,075 tpd

OREGON CITY, ORE.
(Smurfit Newsprint Co.)
Pulp—350 tpd thermomechanical; 345 tpd deinked; 30 tpd semibleached kraft
Newsprint—650 tpd

POMONA, CALIF.
Pulp—420 tpd deinked
Newsprint—375 tpd

BREWTON, ALA.
Pulp—1,300 tpd kraft
Unbleached kraft board—875 tpd
Solid bleached board—525 tpd

SANTA CLARA, CALIF.
Recycled board—325 tpd

VERNON, CALIF.
Recycled boxboard—125 tpd
Recycled medium—350 tpd

FERNANDINA BEACH, FLA.
Pulp—2,100 tpd kraft
Unbleached kraft board—2,200 tpd

CARTHAGE, IND.
Recycled medium—130 tpd

WABASH, IND.
Recycled board—340 tpd

CIRCLEVILLE, OHIO
Pulp—250 tpd semichemical
Semichemical corrugating medium—325 tpd

PHILADELPHIA, PA.
Recycled board—450 tpd

TACOMA, WASH.
Recycled board—110 tpd

Total production capacity:

PULP	
Kraft	4,400 tpd
Semibleached kraft	60 tpd
Semichemical	250 tpd
TMP	350 tpd
Refiner mechanical	460 tpd
Deinked	1,370 tpd
Total	6,890 tpd

PAPER AND BOARD	
Newsprint	2,100 tpd
Linerboard	1,100 tpd
Kraft board	3,600 tpd
Corrugating medium	950 tpd
Recycled board	2,195 tpd
Tube, chipboard	315 tpd
Total	10,710 tpd

Kimberly-Clark Corp.

Box 619100, DFW Airport Station
Dallas, Texas 75261-9100
Darwin E. Smith, chairman
Wayne R. Sanders, president

(million $)

	Net sales	Net earnings
1990	$6,407.3	$432.1
1989	5,733.6	423.8
1988	5,393.5	378.6
1987	4,884.7	325.2
1986	4,303.1	269.4

Kimberly-Clark manufactures a wide range of personal and health care products. The company also makes technical and specialty papers, newsprint, and other communication papers.

Sales of tissue, home and hospital health care products, wipes, and related products totaled $5.1 billion in 1990. Sales of paper, other than tissue, were $1.1 billion.

Capital expenditures were $659 million in 1990. Looking forward, K-C's newsprint mill in Coosa, Ala., is undergoing a five-year, $200-million modernization. The mill plans to manufacture some recycled-content newsprint after a 35,000-tpy deinking plant comes online late in 1991. K-C also plans to invest $50 million at its Huggies baby wipe plant in Maumelle, Ark.

In April 1990, the company introduced a premium single-ply tissue manufactured at a greenfield mill in Jenks, Okla. Later in the year, K-C began operations at a new mill in Loudon, Tenn., adding a second machine at the site in late 1990. The company intends to install a third machine with related deinking and converting equipment at this site.

In August 1991, K-C announced that it would give the Spruce Falls' newsprint operation to a partnership of the mill's employees and Tembec, Inc. This agreement followed the Ontario government's decision to purchase the mill's hydroelectric generating station for C$140 million.

K-C owns 400,000 acres of timberland and leases 7.6 million additional acres.

Production facilities:

COOSA PINES, ALA.
(Coosa River Newsprint)
Pulp—1,200 tpd kraft; 775 tpd groundwood; 120 tpd thermomechanical
Newsprint, groundwood printing paper—1,200 tpd

FULLERTON, CALIF.
Tissue, cellulose wadding—185 tpd

NEW MILFORD, CONN.
Tissue, towels—200 tpd

LEE, MASS.
Cigarette, lightweight specialties—90 tpd

MUNISING, MICH.
(Technical Paper)
Writing, map, specialties—100 tpd

SPOTSWOOD, N.J.
Cigarette plug wrap—130 tpd

ANCRAM, N.Y.
Cigarette plug wrap, technical specialties—15 tpd

JENKS, OKLA.
Tissue—191 tpd

BEECH ISLAND, S.C.
Tissue, wadding, towels—260 tpd

MEMPHIS, TENN.
Tissue, wadding, towels—310 tpd

LOUDON, TENN.
Tissue—99 tpd

NEENAH, WIS.
(Neenah Paper)
Tissue, wadding, towels—275 tpd

NEENAH, WIS.
Wadding, industrial wipers—60 tpd

WHITING (Stevens Point), WIS.
(Neenah Paper)
Bond, cover, text paper—120 tpd

HUNTSVILLE, ONT.
(Kimberly-Clark of Canada)
Wadding—100 metric tpd (110 short)

ST. CATHARINES, ONT.
(Kimberly-Clark of Canada)
Specialty tissue, lightweight—104 metric tpd (115 short)

TERRACE BAY, ONT.
(Kimberly-Clark of Canada)
Pulp—1,135 metric tpd (1,251 short) bleached kraft (some for market)

Total production capacity:

PULP	
Kraft	2,451 tpd
Groundwood	775 tpd
TMP	120 tpd
Total	3,346 tpd

PAPER	
Newsprint/groundwood	1,200 tpd
Tissue	1,805 tpd
Printing/writing, specialty	220 tpd
Cigarette	235 tpd
Total	3,460 tpd

Kruger Inc.

3285 Bedford Rd.
Montreal, Que. H3S 1G5
Joseph Kruger II, chairman/chief executive officer

(million C$)

	Net sales	Net earnings
1990	C$712.4	C$ -11.3
1989	676.5	18.0
1988	714.2	50.1

Kruger is Canada's largest privately owned company in the industry, and it had the first mill to offer newsprint for flexographic printing on a commercial basis.

In 1984, Kruger purchased Bowater Inc.'s Corner Brook, Nfld., mill (now Corner Brook Pulp and Paper Ltd.) and by 1989 had completed a five-year, C$250-million improvement program involving the rebuild of four machines, along with two more thermomechanical pulp lines.

The construction of No. 10 paper machine at the Trois-Rivières, Que., mill was completed in 1990. This 300-in.-trim machine can produce 185,000 metric tpy of newsprint, bringing the company's annual capacity to about 1 million metric tons. The project also included a new TMP facility.

In February 1991, Kruger purchased Manistique Papers Inc. to increase its capacity for recycled-content newsprint and groundwood papers. It is presently studying the feasibility of expanding the site's deinking capacity by 35,000 tpy. Kruger has also invested C$115 million in a 160,000-tpy deinking plant at its flagship mill in Bromptonville, Que.

Production facilities:

CORNER BROOK, Nfld.
Pulp—230 metric tpd sulfite; 900 metric tpd thermomechanical
Newsprint—1,025 metric tpd

BROMPTONVILLE, QUE.
(Newsprint Div.)
Pulp—800 metric tpd thermomechanical
Newsprint—580 metric tpd

MONTREAL, QUE.
(Turcot Paperboard Div.)
Recycled paperboard—300 metric tpd

REXDALE, ONT.
Corrugated containers (from recycled and virgin board)—680,000,000 ft^2/year

TROIS RIVIERES, QUE.
Pulp—880 metric tpd groundwood; 360 tpd TMP
Newsprint—750 metric tpd
Coated paper—400 metric tpd
SC-B—200 metric tpd
(including PM No. 10)

VILLE LASALLE, QUE
Corrugated containers (from recycled and virgin board)—1,164,000,000 ft^2/year

MANISTIQUE, MICH.
Pulp—500 short tpd deinked (454 metric tpd)
Newsprint—250 short tpd (169 metric tpd)
Uncoated groundwood—65 short tpd (59 metric tpd)

Total production capacity:

PULP	
Deinked	454 metric tpd
Groundwood	880 metric tpd
Sulfite	230 metric tpd
TMP	2,060 metric tpd
Total	3,624 metric tpd (consumed on site)

PAPER AND BOARD	
Newsprint	2,523 metric tpd
Coated publication	400 metric tpd
Uncoated groundwood	59 metric tpd
SC-B	200 metric tpd
Recycled board	300 metric tpd
Total	3,482 metric tpd

CORRUGATED CONTAINERS
1,844,000,000 ft^2/year

Longview Fibre Co.

P.O. Box 639
Longview, Wash. 98632
R.P. Wollenberg, chairman/president/chief executive officer

(million $)

	Net sales	Net earnings
1990	$685.4	$61.1
1989	697.7	66.5
1988	657.2	96.3
1987	569.3	65.1
1986	487.6	33.4

(fiscal year ends Oct. 31)

Longview Fibre specializes in kraft linerboard and kraft packaging paper at its Longview, Wash., mill. About 67% of this output goes to the company's 15 converting plants in ten states. In fiscal 1990, about 86% of Longview's sales were derived from pulp, paperboard, and converting operations. Converted products accounted for nearly 51% of sales.

Sales of paper and board in 1990 reached $242 million, and sales of converted products sales were $349 million.

In 1990, total primary production of paper and paperboard was 937,000 short tons. The company sold 273,000 tons of paper, 137,000 tons of paperboard, and 570,000 tons of converted products.

Capital expenditures in 1990 were $133 million. The company has budgeted $90 million for expenditures in 1991.

In October 1990, Longview started up a new kraft paper machine. The project cost $90 million and will increase capacity by 105,000 tpy. A new recovery boiler presently under construction is scheduled for completion in early 1992

During 1991, the company will move a portion of its bag-making equipment to its Spanish Fork, Utah Box Plant in order to improve efficiency and expand its effective market area.

Longview owns 523,000 acres of timberland.

Production facilities:

LONGVIEW, WASH.
Pulp—2,630 tpd kraft; 120 tpd semichemical
Packaging/industrial converting paper—1,200 tpd
Containerboard—1,400 tpd

Total production capacity:

PULP	
Kraft	2,630 tpd
Semichemical	120 tpd
Total	2,760 tpd

PAPER AND BOARD	
Packaging/industrial converting paper	1,200 tpd
Containerboard	1,400 tpd
Total	2,665 tpd

Louisiana-Pacific Corp.

111 S.W. Fifth Ave.
Portland, Ore. 97204
Harry A. Merlo, chairman/president

(million $)

	Net sales*	Net earnings**
1990	$1,793.0	$91.1
1989	2,009.5	192.6
1988	1,799.4	135.2
1987	1,654.2	118.8
1986	1,305.8	62.7

* Restated to reflect June 1988 spin-off of Fibreboard Corp. subsidiary.
** Before extraordinary items.

Louisiana-Pacific manufactures building materials and pulp. The company's pulp sector accounted for 11% of total sales in 1990. Market pulp production was 400,000 short tons, sales were $205 million, and operating profit was $31 million.

Total capital expenditures in 1990 were $375 million. Of this amount, $148 million was spent on the company's pulp sector. The company expects to spend $125 to $150 million in 1991.

In mid-1991, L-P started up a 180,000-tpy, $150-million greenfield facility in Chetwynd, B.C., that has an annual capacity of 180,000 short tons. In 1990, a $70-million project increased capacity at the Samoa, Calif., mill to 245,000 tpy and improved environmental standards with an oxygen delignification system.

L-P owns 1,500,000 acres of timberland and controls another 500,000 acres.

Production facilities:

KETCHIKAN, ALASKA
Pulp—600 tpd dissolving sulfite (for market)

SAMOA, CALIF.
Pulp—600 tpd bleached kraft (for market)

CHETWYND, B.C.
Pulp—525 CTMP (for market)

Total production capacity:

PULP	
Sulfite	600 tpd
Kraft	600 tpd
CTMP	525 tpd
Total	1,725 tpd

MacMillan Bloedel Ltd.

925 W. Georgia St.
Vancouver, B.C. V6C 3L2
R.V. Smith, chairman
Robert Findlay, president/chief executive officer

(MB is 48.8% owned by Noranda Forest Inc. It has a 50% interest in Island Paper Mills Ltd.; Noranda Forest has the other 50%.)

(million C$)

	Net sales	Net earnings
1990	C$3,003.2	C$50.8
1989	3,273.7	246.7
1988	3,273.5	329.8
1987	3,134.5	280.6
1986	2,511.7	178.3

MacMillan Bloedel is one of North America's largest forest products companies, with integrated operations in Canada, the U.S., the U.K., and Continental Europe. It produces kraft pulp, newsprint, groundwood printing papers, fine papers, containerboard, corrugated containers, lumber, and panelboards. The company is emphasizing a program to reduce costs and stress new, value-added products, including groundwood papers and higher-quality newsprint.

Sales of pulp and paper reached C$1,127.5 million in 1990. Newsprint accounted for C$727.4 million; market pulp, C$345.1 million; other, C$55 million. Containerboard and packaging contributed C$456.1 million to sales.

In 1990, MB produced 406,000 metric tons of market pulp, 933,000 metric tons of newsprint and groundwood printing papers, 366,000 tons of linerboard, and 280,000 tons of corrugating medium.

Total capital expenditures in 1990 were C$367 million, of which C$153.9 million was for pulp and paper operations and C$76.6 million was for containerboard and packaging.

In 1990, MB curtailed its production at Harmac to counteract high pulp inventories. This resulted in a 20% decrease in production levels, 74,000 tons below 1989. In mid-1990, the company completed installation of an off-machine coater at its Island Paper mill in Westminster, B.C. The C$62 million modernization of Powell River's #10 newsprint machine was completed in December 1990. MB is investing C$35 million in a twin-wire gap former for a No. 4 paper machine and C$23 million for an automated packaging and computerized production system at the Alberni mill. In 1992, MB expects to complete its project to double the recycling capacity at its Pine Hill, Ala., mill.

MB owns 395,200 acres and controls an additional 3.4 million acres of timberland in North America.

Production facilities:

NANAIMO, B.C.
(Harmac Div.)
Pulp—1,120 metric tpd kraft (for market)

NEW WESTMINSTER, B.C.
(Island Paper Mills Ltd., jointly owned)
Uncoated free-sheet—400 metric tpd (MB's share: 200 metric pd)

PORT ALBERNI, B.C.
(Alberni Pulp & Paper Div.)
Pulp—550 metric tpd unbleached kraft (235 for market); 330 metric tpd bleached kraft; 680 metric tpd groundwood; 85 metric tpd refiner groundwood
Newsprint and/or groundwood specialty—1,000 metric tpd

POWELL RIVER, B.C.
(Powell River Div.)
Pulp—581 metric tpd kraft (150 metric tpd for market); 770 metric tpd groundwood; 1,100 metric tpd chemi-thermomechanical/TMP
Newsprint/groundwood paper—1,900 metric tpd

STURGEON FALLS, ONT.
Pulp—275 metric tpd semichemical
Corrugating medium—230 metric tpd

PINE HILL, ALA.
(MacMillan Bloedel Inc.)
Pulp—1,075 short tpd (975 metric) unbleached kraft; 430 short tpd (390 metric) semichemical
Linerboard—1,250 short tpd (1,133 metric)
Corrugating medium—600 short tpd (544 metric)

Total production capacity:

PULP	
Kraft	3,556 metric tpd
Semichemical	665 metric tpd
Groundwood	1,535 metric tpd
CTMP	1,100 metric tpd
Total	6,856 metric tpd
PAPER AND BOARD	
Newsprint/groundwood specialty	2,900 metric tpd
Uncoated free-sheet	200 metric tpd
Linerboard	1,133 metric tpd
Corrugating medium	544 metric tpd
Total	4,777 metric tpd

Macon Kraft Inc.

4891 Mead Rd.
P.O. Box 3215
Macon, Ga. 31298
Gene Schutt, president

Financial data not available.

The Macon mill uses 40% recycled fiber in its operation, with one machine mainly producing kraft linerboard and the second machine turning out recycled linerboard. The Macon mill was acquired by Australia's Pratt Group in 1987 for an estimated $270 million following the breakup of Georgia Kraft, a joint venture between Mead Corp. and Temple-Inland Inc.

The new owner announced plans to invest about $170 million in the mill, spread over several years. But the ambitious capital program combined with a weak linerboard market in the early 1990s have placed financial strain on the company. In early 1991, the company postponed a $90-million recovery boiler project after Georgia's Dept. of Natural Resources granted Pratt an open ended extension to comply with environmental requirements.

In mid-1990, Jefferson Smurfit was rumored to have initiated discussions with Pratt for the purchase of Macon Kraft. Chairman Richard Pratt confirmed that negotiations had taken place, but no deals were imminent.

In September 1991, it was indicated that Macon Kraft and Riverwood International Corp. were discussing several joint manufacturing and marketing options that could lead to the production of coated kraft board at the Macon mill.

Production facilities:

MACON (Krannert), GA.
Pulp—900 tpd kraft
Kraft linerboard—1,700 tpd

Total production capacity:

PULP	900 tpd
PAPERBOARD	1,700 tpd

Mead Corp.

Courthouse Plaza Northeast
Dayton, Ohio 45463
Burnell R. Roberts, chairman/chief executive officer

(Mead has a 50% interest in Northwood Forest Industries [with Noranda Forest Inc.].)

(million $)

	Net sales	Net earnings
1990	$4,772.0	$38.5
1989	4,608.2	215.8
1988	4,463.9	352.7
1987	4,208.8	216.7
1986	3,217.7	5.8

Mead segments include paper, packaging and paperboard, distribution and school and office products, and electronic publishing. The purchase of Zellerbach Distribution Group in May 1986 made Mead, at the time, the largest U.S. integrated distributor of paper. In the last six years, the company has been shifting focus from commodity-oriented to value-added products. A number of operations that no longer fit the strategic plan were divested, as the company emphasized coated board and paper as well as its electronic publishing businesses. Not all of the company's "value-added" ventures have been successful, however, and in 1990, Mead Imaging was discontinued after several years of trying to develop and market Cycolor, a new color copy technology.

In 1990, Mead produced 1,206,000 tons of paper, 869,000 tons of paperboard, and, on an equity basis, 231,000 tons of dry pulp (113,000 tons of which was used internally).

The net sales breakdown in 1990 was as follows: paper, $1,178 million (25% of total sales); packaging and paperboard, $970 million (20%), distribution and school and office products, $2,184 million (48%), and electronic publishing, $440 million (9%).

Total capital spending for 1990 equaled 489.6 million. Eighty-five percent of this went to the forest products area. During the year, Mead completed the $580-million construction of a new 370,000-tpy coated natural kraft board expansion of its Mahrt mill in Phenix City, Ala. The company expects total capital expenditures to drop to $350 million in 1991.

Mead owns 1,270,000 acres of timberland and controls an additional 106,000 acres.

Production facilities:

PHENIX CITY (Mahrt)) ALA.
(Coated Board Div.)
Pulp—1,625 tpd unbleached kraft
Coated board—2,200 tpd

STEVENSON, ALA.
(Containerboard Div.)
Pulp—750 tpd semichemical
Corrugating medium—1,030 tpd

SOUTH LEE, MASS.
(Specialty Paper Div.)
Specialty paper—70 tpd

ESCANABA, MICH.
(Publishing Paper Div.)
Pulp—1,050 tpd kraft
250 tpd groundwood
Printing/writing paper—1,480 tpd

CHILLICOTHE, OHIO
(Fine Paper Div.—Chillicothe and Chilpaco mills)
Pulp—870 tpd kraft
Carbonless paper—457 tpd
Coated—371 tpd
Uncoated—457 tpd

KINGSPORT, TENN.
(Fine Paper Div.)
Pulp—250 tpd bleached hardwood soda
Coated—186 tpd
Uncoated—386 tpd

MENASHA, WIS.
(Gilbert Paper Co.)
Rag-content, security paper—265 tpd

PRINCE GEORGE, B.C.
(Northwood Forest Industries)
Kraft pulp—795 metric tpd (876 short)

Total production capacity:

PULP	
Kraft	4,421 tpd
Soda	250 tpd
Semichemical	750 tpd
Groundwood	250 tpd
Total	5,671 tpd
PAPER	
Printing/writing	2,880 tpd
Rag-content	265 tpd
Specialty	70 tpd
Carbonless	457 tpd
Total	3,672pd
PAPERBOARD	
Corrugating medium	1,030 tpd
Coated board	2,200 tpd
Total	3,230 tpd
TOTAL PAPER AND BOARD	6,110 tpd

The Newark Group Inc.

20 Jackson Drive
Cranford, N.J. 07016
Edward K. Mullen, chairman/chief executive officer

(California Paperboard Corp., Franklin Boxboard Corp., Haverhill Paperboard Corp., Middletown Paperboard Corp., Mobile Paperboard Corp., Natick Paperboard Corp., Newark Atlantic Paperboard Corp., Newark Boxboard Co., Newark Pacific Paperboard Corp., Wisconsin Paperboard Corp., and Newark Sierra Paperboard are all part of the Paperboard Mill Div. of The Newark Group Inc.)

Financial data not available.

In 1988, the company established Newark Pacific Paperboard Corp. within the Paperboard Mill Div. to acquire the clay-coated recycled paperboard mill of Federal Paper Board Co. Inc. at Los Angeles, Calif.

The Newark Group purchased from National Gypsum Co. a two-cylinder machine mill in Stockton, Calif., in the summer of 1989. The mill is now being operated as Newark Sierra Paperboard Corp.

Newark has recently expanded its recycling facilities, which now include Great Eastern Packing & Paper Stock Co. and Schaffer-Stein Corp. of Shreveport, La. In 1990, Newark expanded its converting and finishing services to the Northeast by opening a new plant in Nashua, N.H. The new plant will operate as Newark Fiber Products and will provide converting, finishing, laminating, and sheeting services for New England mills.

Capital expenditures for 1990 amounted to $15 million and are expected to decrease to $10 million in 1991.

Production facilities:

FRANKLIN, OHIO
(Franklin Boxboard Corp.)
Recycled paperboard—180 tpd

HAVERHILL, MASS.
(Haverhill Paperboard Corp.)
Recycled paperboard—300 tpd

LAWRENCE, MASS.
(Newark Atlantic Paperboard Corp.)
Clay-coated recycled paperboard—200 tpd

LOS ANGELES (City of Commerce), CALIF.
(Newark Pacific Paperboard Corp.)
Clay-coated recycled paperboard—165 tpd

MIDDLETOWN, OHIO
(Middletown Paperboard Corp.)
Recycled paperboard—130 tpd

MILWAUKEE, WIS.
(Wisconsin Paperboard Corp.)
Recycled paperboard—420 tpd

MOBILE, ALA.
(Mobile Paperboard Corp.)
Recycled paperboard—350 tpd

NATICK, MASS.
(Natick Paperboard Corp.)
Recycled paperboard—110 tpd

NEWARK, N.J.
(Newark Boxboard Co.)
Recycled paperboard—130 tpd

SANTA CLARA, CALIF.
(California Paperboard Corp.)
Recycled paperboard—300 tpd

STOCKTON, CALIF.
(Newark Sierra Paperboard Corp.)
Recycled paperboard—270 tpd

Total production capacity:

PAPERBOARD	
Recycled	2,555 tpd

Noranda Forest Inc.

(Sub. of Noranda Inc.)
Suite 4414, P.O. Box 7
Toronto Dominion Bank Tower
Toronto, Ont. M5K 1A1
Adam Zimmerman, chairman
K. Linn Macdonald, chief executive officer

(Noranda Inc. owns about 82% of Noranda Forest Inc. Noranda Forest Inc.'s major operating interest includes 100% of Fraser Inc., James Maclaren Industries Inc., Noranda Forest Sales, Norbord Industries, Noranda Forest Recycled Papers, and Normick Perron Inc., which in turn has a 42% interest in Donohue-Normick Inc. Noranda Forest also owns 50% of Northwood Panelboard, 50% of Northwood Pulp & Timber Ltd., and 49% of MacMillan Bloedel Ltd. [listed separately in Company Profiles]. In addition, the company and MB are joint-venture partners in Island Paper Mills Co.)

(million C$)

	Net sales	Net earnings
1990	C$4,555.0	C$-95.0
1989	4,868.0	189.0
1988	4,715.0	263.0
1987	4,470.0	203.2
1986	3,736.0	102.7

Noranda Forest Inc. was established in 1987 as the forest products holding company for Noranda Inc., one of Canada's largest diversified natural resource companies.

In 1990, approximately 33% of Noranda Forest's consolidated sales came from pulp and paper products, 11% came from paperboard packaging, 12% from pulp, and 44% from building and other.

Noranda Forest spent C$569 million on capital outlays in 1990. Projects that were completed in 1990 include the installation of an C$82-million off-machine coater at the Island Paper Mills facility in Vancouver, B.C.; the modernization of the No. 10 newsprint machine at Powell River, B.C.; the $176-million, 75,000-metric-tpy capacity expansion at the Thurso, Que., bleached hardwood pulp mill; and the product quality improvement program at MacMillan Bloedel Inc.'s Pine Hill, Ala., containerboard mill.

Noranda Forest expected to spend approximately C$400 million on capital expenditures in 1991, most of which is required to complete projects already in progress, with the remainder to be spent on environment-related projects.

In November 1991, the Atholville pulp mill in New Brunswick was shut down indefinitely.

Noranda Forest, including 100% of all affiliates, owns 700,000 hectares of timberland in North America and controls 5,300,000 hectares.

Production facilities:
(Also see seperate listing for MacMillan Bloedel.)

NEW WESTMINSTER, B.C.
(Island Paper Mills Co.—joint venture with MacMillan Bloedel)
Printing/writing papers—400 metric tpd

ATHOLVILLE, N.B.
(Fraser Inc.)
(Shut down indefinitely 11/91)
Pulp—360 metric tpd magnesium bisulfite (for market)

EDMUNDSTON, N.B.
(Fraser Inc.)
Pulp—340 metric tpd groundwood; 365 metric tpd bleached softwood sulfite; 225 metric tpd unbleached and semibleached sulfite
Paperboard—100 metric tpd coated and uncoated boxboard

THOROLD, ONT.
(Noranda Forest Recycled Papers)
Pulp—125 metric tpd deinked
Coated and uncoated free-sheet—310 metric tpd

MADAWASKA, MAINE
(Fraser Inc.)
Uncoated groundwood paper—840 short tpd (762 metric)
Uncoated free-sheet—418 short tpd (379 metric)
Coated paper—430 short tpd (390 metric)

MASSON (Buckingham), QUE.
(James Maclaren Industries Inc.)
Pulp—420 metric tpd groundwood; 200 metric tpd sulfite
Newsprint—525 metric tpd

THURSO, QUE.
(James Maclaren Industries Inc.)
Pulp—580 metric tpd bleached kraft (for market)

PRINCE GEORGE, B.C.
(Northwood Pulp & Timber Ltd.—see Mead Corp.)

Total production capacity:
(Does not include MacMillan Bloedel or Northwood Pulp & Timber. Does not include Atholville mill.)

PULP	
Kraft	580 metric tpd
Sulfite	790 metric tpd
Groundwood	760 metric tpd
Deinked	125 metric tpd
Total	2,255 metric tpd

PAPER AND BOARD	
Newsprint	525 metric tpd
Printing/writing	2,241metric tpd
Paperboard	100 metric tpd
Total	3,227 metric tpd

Packaging Corp. of America

(Subsidiary of Tenneco Inc.)
1603 Orrington Ave.
Evanston, Ill. 60204
Monte R. Haymon, president/chief executive officer

(million $)

	Net sales	Operating income
1990	$1,476.0	$190.0
1989	1,343.0	200.0
1988	1,304.9	215.0
1987	1,153.2	166.0
1986	953.0	110.0

Packaging Corp. of America made several acquisitions between 1985 and 1989 in order to become a full-line packaging company.

The company produced 1,228,081 tons of paper and paperboard and 159,723 tons of pulp, consumed internally, in 1990. About 68% of company sales and 65% of operating profits came from pulp, paper, paperboard, and converted products. Total capital expenditures in 1990 were $137 million.

In late 1990, PCA purchased a mill in Sylva, N.C., as a part of the Dixie Container Corp. acquisition. The facility produces 75,000 tpy of 100%-recycled medium. In January 1991, PCA obtained two mills from Georgia-Pacific Corp. in a leveraged lease arrangement with GE Capital. The mills, located in Valdosta, Ga., and Tomahawk, Wis., significantly enhance PCA's production of heavy-weight grades and semichemical medium. The company now has capacity for 1.135 million tpy for linerboard and 790,000 tpy for medium.

Much of the containerboard produced at PCA's five paperboard mills is converted at the company's 58 U.S. container plants.

Not including 540,000 acres leased pursuant to the G-P transaction in early 1991, PCA owns 403,000 acres and controls another 78,000 acres of forestland.

Production facilities:

CITY OF INDUSTRY, CALIF.
Molded pulp products—18 tpd

RED BLUFF, CALIF.
Molded pulp products—125 tpd

MACON, GA.
Molded pulp products—80 tpd

VALDOSTA, GA.
Pulp—1,130 tpd kraft
Linerboard—1,100 tpd

GRIFFITH, IND.
Molded pulp products—62 tpd

TAMA, IOWA, and RITTMAN, OHIO
Recycled board—525 tpd together

FILER CITY, MICH.
Pulp—600 tpd semichemical
Corrugating medium—800 tpd

SYLVA, N.C.
(Jackson Paper Manufacturing Co.)
Recycled medium—210 tpd

PLATTSBURGH, N.Y
Molded pulp products—45 tpd

COUNCE, TENN.
(Tennessee River Pulp & Paper Co.)
Pulp—1,700 tpd kraft
Linerboard—2,000 tpd

TOMAHAWK, WIS.
Pulp—1,000 tpd semichemical
Corrugating medium—1,200 tpd

Total production capacity:

PULP	
Molded pulp products	350 tpd
Kraft	2,830 tpd
Semichemical	1,600 tpd
Total	2,650 tpd
PAPERBOARD	
Recycled board	730 tpd
Corrugating medium	1,825 tpd
Linerboard	3,100 tpd
Total	3,530 tpd

Paperboard Industries Corp.

144 Front St. West, Suite 600
Toronto, Ont. M5J 1G2
Douglas McKinnon, chief operating officer

(Paperboard Industries Corp. went private in early 1988; therefore, some financial data is not available for that and the following years. Belkin Inc. was amalgamated into PIC in September 1987.)

(million C$)

	Net sales	Net earnings
1990	C$628.1	n.a.
1989	659.9	n.a.
1988	577.2	n.a.
1987*	203.7	C$3.0
1986	79.8	3.2

(fiscal year ends Aug. 31)
*Includes three months of Belkin Inc. operations.
n.a. = not available.

Paperboard Industries is owned by Kinburn Corp., an Ottawa, Ont.-based holding company controlled by Roderick Bryden. Following the acquisition of Belkin Inc. in September 1987, Paperboard Industries became a significant player in collecting wastepaper, manufacturing recycled paperboard, and converting and selling packaging products.

In 1990, the company produced 421,500 metric tons of paper and paperboard. Over the past year, however, Kinburn has been trying to sell the company. In summer 1991, Sonoco Products Co. and Coretech Corp. of Canada agreed to form a joint venture to purchase Paperboard Industries' small Montreal-based uncoated boxboard and core board mill as well as its 50% interest in Coretech's four paper tube and core plants. Then, in September 1991, the company announced it had completed the sale of the Big M Paperboard Inc. mill in Palmyra, Mich., to Merritt Sorenson.

Paperboard Industries spent $29 million in 1990 and has allocated $22 million for capital expenditures in 1991.

Production facilities:

BURNABY, B.C.
(Former Belkin Inc. mill)
Paperboard—525 metric tpd containerboard, boxboard

TORONTO, ONT.
(Former Belkin Inc. mill)
Paperboard—400 metric tpd coated linerboard, boxboard

TRENTON (Glen Miller), ONT.
(Trent Valley Div., West and East mills)
Paperboard—350 metric tpd boxboard or linerboard

MONTREAL QUE.
(Former Belkin Inc. mill—to be sold)
Paperboard—100 metric tpd boxboard, core stock

Total production capacity:

PAPERBOARD	1,375 metric tpd

Parsons & Whittemore Inc.

4 International Drive
Rye Brook, N.Y. 10573
Arthur L. Schwartz, president

Financial data not available.

Parsons & Whittemore Inc. is one of the largest privately owned companies in the North American pulp and paper industry.

In late 1989, P&W broke ground on the $700-million Alabama Pine Pulp Co. facility, a 474,000-tpy bleached softwood pulp mill adjacent to its Alabama River Pulp facility. The new mill is targeted to come online in December 1991.

In July 1990, the Alabama River Newsprint Co., a joint venture between P&W and Abitibi-Price Inc., started up a 243,000-tpy greenfield newsprint mill. The project was designed and constructed by P&W but is now operated by Abitibi. The company intends to install a deinking facility at the site by the end of 1992.

Production facilities:

CLAIBORNE, ALA.
(Alabama River Pulp Co.—Claiborne Div.)
Pulp—1,150 metric tpd (1,043 short tpd) bleached hardwood and softwood kraft (for market)

NACKAWIC, N.B.
(St. Anne-Nackawic Pulp & Paper Co. Ltd.)
Pulp—680 metric tpd (617 short tpd) bleached hardwood kraft (for market)

CLAIBORNE, ALA.
(Alabama River Newsprint Co.—see Abitibi-Price Inc.)

Total production capacity:
(Does not include Alabama River Newsprint Co.)

PULP	1,830 metric tpd

Pentair Inc.

1700 W. Highway 36
St. Paul, Minn. 55113
D.Eugene Nugent, chairman/chief executive officer
Winston H. Buxton, president

(Wholly owned subsidiaries are Niagara of Wisconsin Paper Corp. and Cross Pointe Paper Corp. Lake Superior Paper Industries (LPSI) is a 50:50 joint venture with Minnesota Power.)

(million $)

	Net sales	Net earnings*
1990	$1,175.9	$33.0
1989	1,163.6	36.4
1988	823.3	39.8
1987	789.2	21.9
1986	623.9	15.2

* Includes 50% of LPSI's income.

Lake Superior Paper Industries

	Net sales	Pretax income
1990	$169.7	$ 9.5
1989	160.8	12.7
1988	111.1	3.0

Formed in 1966, Pentair has grown through acquisitions of inefficient operations that it turns into autonomous, profitable subsidiaries. The company focuses on higher-value printing/writing and publications papers. In 1987, it sold off two specialty papers mills that it bought from Port Huron Paper Corp. in 1983. In mid-1988, Pentair combined Miami Paper and Flambeau Paper under the name Cross Pointe Paper Corp. The Lake Superior Paper Industries (LPSI) mill, which came online in late 1987, is the first mill Pentair has been involved in building.

The $400-million, 240,000-tpy joint venture between Pentair and Minnesota Power gave Pentair entrance into the fast-growing supercalendered paper market.

Pentair's paper unit sales, which do not include LPSI, tallied $371 million, or 31% of total consolidated sales in 1990. LPSI recorded sales of $170 million. Pentair's wholly owned subsidiaries produced 436,553 tons of paper and 188,155 tons of pulp (all consumed internally) in 1990. LPSI produced 220,000 tons of paper and 114,500 tons of pulp (all consumed internally).

The company spent $33.3 million in 1990 on capital projects. Total capital spending in 1991 is expected to be $30.4 million. The company recently converted the Flambeau mill from an acid to an alkaline papermaking process. The deinking plant at Pentair's Miami mill was expanded in order to increase capacity and permit the production of 100% recycled premium papers. In addition, 1990 marked the startup of a $38-million pressurized groundwood pulp mill at the Niagara, Wis., mill. This is the first system to use aspen exclusively as a raw material to produce bleached pulp with high opacity and bonding strength. Niagara also introduced a new coated publication paper, Recycle Gloss, which contains 50% recycled fiber. And in January 1991, a $10-million modernization of No. 4 paper machine was completed.

Production facilities:

DULUTH, MINN.
(Lake Superior Paper Industries)
Pulp—440 tpd pressurized groundwood
Supercalendered paper—620 tpd

WEST CARROLLTON, OHIO
(Cross Pointe Paper Corp.)
Pulp—150 tpd deinked
Uncoated free-sheet—300 tpd

NIAGARA, WIS.
(Niagara of Wisconsin Paper Corp.)
Pulp—250 tpd pressurized groundwood
Coated groundwood—650 tpd

PARK FALLS, WIS.
(Cross Pointe Paper Corp.)
Pulp—120 tpd sulfite
Uncoated free-sheet—375 tpd

Total production capacity:

PULP	
Deinked	150 tpd
Groundwood	690 tpd
Sulfite	120 tpd
Total	960 tpd
PAPER	
Coated groundwood	650 tpd
Uncoated free-sheet	675 tpd
Supercalendered	620 tpd
Total	1,945 tpd

Pope & Talbot Inc.

1500 S.W. First Ave.
Portland, Ore. 97201
Peter T. Pope, chairman/president/chief executive officer

(million $)

	Net sales	Net earnings
1990	$562.5	$19.8
1989	613.9	43.6
1988	512.1	31.9
1987	424.2	28.1
1986	308.8	15.8

Pope & Talbot has two businesses: wood products and pulp and paper products. Accounting for 66% of company sales, the pulp and paper segment produces bleached kraft pulp, tissue products, and diapers. Recent acquisitions and construction support the company's long-term goal to produce private-label and generic tissue and disposable diapers at low-cost facilities.

In 1990, pulp and paper products contributed $370 million in sales and $43 million in operating profit. During the year, the company produced 138,000 tons of tissue and about 340,000 tons of pulp (including 196,000 tons of bleached softwood pulp for market).

Total 1990 capital expenditures were $41.8 million, 73% of which was for pulp and papermaking operations.

Over the next five to seven years, Pope & Talbot will need to commit $40 to $50 million to bring the mill in Halsey, Ore., up to environmental standards. To help justify the outlay, the company is considering the installation of a new line with capacity of 1,100 tpd that would start up in 1994-95. If this project were to go through, it would cost an estimated $400 million.

As of early 1991, Pope & Talbot owned 23,800 acres of timberland in the U.S.

Production facilities:

HALSEY, ORE.
(Pope & Talbot Pulp Inc.)
Pulp—565 tpd bleached softwood and hardwood kraft (for market)

RANSOM, PA.
(Absorbent Products Div.)
Pulp—155 tpd deinked
Tissue—150 tpd

EAU CLAIRE, WIS.
(Absorbent Products Div.)
Pulp—245 tpd deinked
Paper—175 tpd tissue, towel

LADYSMITH, WIS.
(Absorbent Products Div.)
Pulp—90 tpd deinked
Paper—85 tpd tissue, wadding

Total production capacity:

PULP	
Bleached kraft	565 tpd
Deinked	490 tpd
Total	1,055 tpd
PAPER	
Tissue	410 tpd

Potlatch Corp.

One Maritime Plaza
San Francisco, Calif. 94111
Richard B. Madden, chairman/chief executive officer

(million $)

	Net sales	Net earnings
1990	$1,252.9	$98.6
1989	1,227.6	136.7
1988	1,084.0	112.4
1987	992.1	87.6
1986	976.4	69.9

Potlatch is a diversified forest products company that makes bleached pulp, paperboard, and packaging; coated free-sheet paper; private-label tissue; and lumber and panel products. The company emphasizes high-value-added products that are less vulnerable to economic cycles. Of total sales, about 79% is derived from pulp, paper/paperboard, and converted products.

Paper sales in 1990 reached $374.7 million (30% of total sales); pulp and paperboard sales were $392.5 million (31%); tissue sales were $140 million (11%); liquid containers, $83 million (7%); and wood products, $263 million (21%).

Potlatch has capacity for 879,800 tpy of bleached kraft pulp, 574,500 tpy of bleached paperboard, 303,200 tpy of printing paper, and 86,100 tpy of tissue and toweling. Pulp output in 1990 was about 869,000 tons. Total paper/paperboard production was approximately 972,000 tons, including 311,000 tons of printing paper, 87,000 tons of tissue, and 574,000 tons of paperboard.

Capital expenditures totaled $317.7 million in 1990. About $193.3 million of that amount was spent on pulp and paper operations.

In June 1990, Potlatch announced plans for a $450-million pulp expansion at Cloquet, Minn., which would increase pulp capacity by 200,000 tpy. The pulp mill at Potlatch's Lewiston, Idaho, complex is being upgraded at a cost of $125 million to include an oxygen delignification system and a new bleaching system that substitutes chlorine dioxide for chlorine in the first chlorination stage. At this site, the company also plans to install a new $95-million, high-speed tissue machine scheduled to start up in September 1992.

Production facilities:

McGEHEE, ARK.
(Cypress Bend Pulp Mill)
Pulp—605 tpd bleached kraft (small amount for market)
Bleached paperboard—661 tpd

LEWISTON, IDAHO
(Paperboard Div.)
Pulp—1,345 tpd bleached kraft (some for market)
Bleached paperboard—950 tpd

LEWISTON, IDAHO
(Consumer Products Div.)
Tissue—248 tpd

BRAINERD, MINN.
(Northwest Paper Div.)
Coated free-sheet—333 tpd

CLOQUET, MINN.
(Northwest Paper Div.)
Pulp—525 tpd bleached kraft
Coated free-sheet—512 tpd

Total production capacity:

PULP	2,475 tpd
PAPER AND BOARD	
Coated	845 tpd
Tissue	248 tpd
Paperboard	1,611 tpd
Total	2,704 tpd

Procter & Gamble Co.

1 Procter & Gamble Plaza
Cincinnati, Ohio 45202
Richard R. Nicolosi, group vice president, P&G Paper Products
David B. Ferraro, group vice president, P&G Cellulose

(Wholly owned subsidiaries are Procter & Gamble Paper Products Co. and Procter & Gamble Cellulose)

Financial data not available.

Procter & Gamble first entered the pulp and paper business in 1921 as the Buckeye Cellulose Corp. with a plant in Memphis, Tenn. The company expanded through construction of its Foley, Fla., pulp mill in 1951. In 1957, P&G acquired a company with two tissue mills in the Midwest. It was renamed Charmin Paper and expanded into a national producer with the addition of mills at Mehoopany, Pa. (built 1966); Oxnard, Calif. (acquired from International Paper Co. in 1974); and Albany, Ga. (built in 1971). The company backed its expansion into tissue with an aggressive marketing program and the development of superior products.

Charmin was the first producer to commercialize through-air predrying of tissue paper, a technology that offers improved softness and absorbency. The company first entered the disposable diaper market in 1961, when it began to test market its Pampers brand in Peoria, Ill. This brand, along with the Luvs premium diaper introduced in 1976, helped P&G establish a significant position in the disposable diaper market. The company's share, however, has declined from over 70% in the 1970s to an estimated 50% in the early 1990s. P&G is meeting the challenge in this highly competitive market by introducing product improvements in Ultra Pampers Plus and Luvs Deluxe. The gender-specific Luvs Deluxe was introduced nationally in November 1988 as the latest technology to prevent leakage and improve fit.

The company's tissue mills and diaper converting plants are supplied with pulp by its Foley, Fla., Grand Prairie, Alta., and Oglethorpe, Fla., pulp mills.

In late 1990, P&G restarted an idled machine at its Green Bay, Wis., mill. P&G has also announced plans for a $100-million expansion of its tissue mill in Oxnard, Calif. In addition, in fall 1991, the company purchased Facelle Co. from Canadian Pacific Forest Products Ltd. for C$186.4 million. Previously, Procter & Gamble had also indicated that it was considering a $250-million project to add two new paper machines at one of its plants east of the Rockies.

Production facilities:
(Procter & Gamble does not release capacity figures; the following are estimates.)

OXNARD, CALIF.
(Procter & Gamble Paper)
Tissue grades—50 tpd

FOLEY (Perry), FLA.
(Buckeye Cellulose Corp.)
Pulp—1,215 tpd dissolving, fluff, and paper-grade kraft

ALBANY, GA.
(Procter & Gamble Paper)
Tissue grades—500 tpd

OGLETHORPE, GA.
(Buckeye Cellulose Corp.)
Pulp—750 tpd bleached kraft (mainly fluff pulp)

MEHOOPANY, PA.
(Procter & Gamble Paper)
Pulp—250 tpd sulfite
Tissue grades—750 tpd

MEMPHIS, TENN.
(Buckeye Cellulose Corp.)
Pulp—243 tpd cotton linters

GREEN BAY, WIS.
(Procter & Gamble Paper: East River & Fox River mills)
Tissue grades—1,000 tpd

GRANDE PRAIRIE, ALTA.
(Procter & Gamble Cellulose Ltd.)
Pulp—900 metric tpd (925 short) bleached kraft (partly for market)

TORONTO, ONT.
(Facelle Co.)
Tissue grades—250 tpd

Total production capacity:

PULP (short tons)	
Cotton linters	243 tpd
Sulfite	250 tpd
Kraft	2,890 tpd
Total	3,383 tpd

PAPER	
Tissue	2,550 tpd

Quebec & Ontario Paper Co. Ltd.

80 King St., 8th floor
St. Catharines, Ont. L2R 7G2
William McNally, chief executive officer

(Quebec & Ontario Paper Co. Ltd. and its QNS Paper Co. Ltd. subsidiary are owned by Chicago-based Tribune Co.)

(million C$)

	Net sales	Net earnings
1990	$412.0	$-23.7
1989	547.0	37.8
1988	584.4	74.2
1987	513.7	67.3
1986	528.2	31.8

Q&O manufactures newsprint and operates one of the largest newspaper recycling programs in Canada. Newsprint output in 1990 reached 594,000 metric tons. Newsprint net revenues decreased 34% from 1989 to $372.7 million. The major factors contributing to the decrease were strikes, unfavorable fluctuations in the Canadian/U.S. exchange rate, and increased price discounting.

Capital expenditures dropped from $141 million in 1989 to $58 million in 1990.

A 600-metric-tpd thermomechanical pulp mill at Baie Comeau, Que., replacing the sulfite pulping operation, started up in 1990. At the Thorold, Ont., mill, a capital project was undertaken to increase production of flotation deinked pulp by 20% and to boost the company's purchases of paper for recycling. The Thorold sheet will now have a 62% recycled content.

Q&O owns 263,000 acres of timberland in Canada and controls 5.8 million acres.

Production facilities:

THOROLD, ONT.
Pulp—450 metric tpd thermomechanical; 530 tpd deinked news
Newsprint—904 metric tpd

BAIE COMEAU, QUE.
(QNS Paper Co. Ltd.)
Pulp—425 metric tpd sulphite; 1300 metric tpd groundwood; 248 tpd metric refiner
Newsprint—1,350 metric tpd

Total production capacity:

PULP	
Groundwood	1,548 metric tpd
Sulfite	425 metric tpd
TMP	450 metric tpd
Deinked news	530 metric tpd
Total	2,953 metric tpd

PAPER	
Newsprint	2,062 metric tpd

Repap Enterprises Corp. Inc.

1150 Peel St., Suite 3200
Montreal, Que. H3B 4V9
George S. Petty, chairman/chief executive officer

(million C$)

	Net sales	Net Earnings
1990	C$1,102.3	C$3.1
1989	1,104.6	93.1
1988	934.9	92.8
1987	844.0	62.5
1986	546.1	13.0

Specializing in the production of high-quality coated paper for magazines and advertising materials and of softwood kraft pulp, Repap operates four major production entities in Canada and the U.S.: Miramichi Pulp & Paper Inc. in New Brunswick, Skeena Cellulose Inc. in Northern British Columbia, Midtec Paper Corp. in Wisconsin, and Repap Manitoba (formerly Manfor Ltd.) in The Pas, Man.

In 1990, Repap had the capacity to produce approximately 972,000 short tpy of coated paper, 680,000 metric tpy of kraft pulp, and 157,000 metric tpy of groundwood pulp. Actual production in 1990 totaled 705,000 short tons of coated paper, 559,000 metric tpy of kraft pulp, and 140,000 metric tons of groundwood pulp.

Repap spent C$355 million on capital expenditures in 1990 and expects to spend C$57 million in 1991.

Construction was completed in 1990 on a C$100-million environmental program to improve the quality of water and air effluents at the Skeena mill. The startup phase of Miramichi's A-2 Coated Paper Complex in Newcastle, N.B., was also completed in 1990, as was construction of a new chemical recovery boiler and turbo generator there.

Repap has acquired the rights to the Alcell pulping process for making hardwood pulp. Alcell uses alcohol instead of sulfur, and it has the potential for small-scale "mini-mills." The first Alcell commercial-size trial plant was constructed at Miramichi at a cost of C$70 million and started up in March 1989.

Repap holds forest licenses to 16 million acres of prime timber resources, 1.8 million acres supplying the Miramichi operations, and 1.9 million acres supplying the Skeena operations.

Production facilities:

KIMBERLY, WIS.
(Midtec Paper Corp.)
Pulp—120 metric tpd groundwood
Coated paper—1,300 metric tpd

NELSON-MIRAMICHI, N.B.
(Miramichi Pulp & Paper Inc.)
Pulp—350 metric tpd groundwood

NEWCASTLE, N.B.
(Miramichi Pulp & Paper Inc.)
Pulp—528 metric tpd kraft
Coated paper—1,350 metric tpd

WATSON ISLAND, B.C.
(Skeena Cellulose Inc.)
Pulp—1,400 metric tpd bleached kraft (for market)

THE PAS, MANITOBA
(Repap Manitoba)
Kraft paper—440 metric tpd

Total production capacity:

PULP	
Groundwood	470 metric tpd
Kraft	1,928 metric tpd
Total	2,398 metric tpd
PAPER	
Coated	2,650 metric tpd
Kraft	440 metric tpd
Total	3,090 metric tpd

Riverwood International Corp.

P.O. Box488
West Monroe, La. 71294-0488
Thomas H. Johnson, president

(million $)

	Net sales	Operating income
1990	$892.4	$159.2
1989	776.6	185.6
1988	667.3	127.1
1987	595.6	100.2

Riverwood International Corp. is the forest products subsidiary of Denver-based Manville Corp., which emerged from bankruptcy on Nov. 28, 1988.

Approximately 83% of Manville Forest Products' sales come from pulp, paper, and paperboard products. The West Monroe, La., mill was a pioneer in developing clay-coated kraft board (solid unbleached sulfite) grades used in beverage carriers and folding cartons.

Production of paper and board, including international affiliates, was about 1,162,000 short tons in 1990. Pulp output was 617,600 tons.

In mid-1990, a new $40-million recovery boiler installation and evaporator modification was completed, allowing the West Monroe mill to reduce operating costs and boost operating margins.

The mill is continuing its modernization program by embarking on a new $40-million capital program, with $14 million committed to additional upgrades. A plan is under consideration to install recycling equipment to process wastepaper at some time in the near future.

In 1991, the Packaging Div. purchased the Jak-et-Pak machinery system from Federal Paper Board Co. Inc. and Syspak SA in Spain. To streamline its operations, Riverwood sold a folding carton plant in Madison, Wis., and a paper tube manufacturing plant in Jacksonville, Ill., in 1991.

Riverwood spent a record $223 million in capital spending, including acquisitions in 1990, and is prepared to spend $170 million or more in 1991.

Riverwood owns over 760,000 acres of U.S. timberland.

Production facilities:

WEST MONROE, LA.
Pulp—1,700 tpd kraft; 270 tpd semichemical
Kraft paper—125 tpd
Paperboard—1,650 tpd
Corrugating medium—300 tpd

Total production capacity:

PULP	
Kraft	1,700 tpd
Semichemical	270 tpd
Total	1,970 tpd
PAPER AND BOARD	
Paperboard	1,650 tpd
Kraft paper	125 tpd
Corrugating medium	300 tpd
Total	2,075 tpd

Rock-Tenn Co.

Box 4098
Norcross, Ga. 30091
A.W. Brown, chairman
Bradley Currey, Jr., president

(million $)

	Net sales
1990	$541.7
1989	515.9
1988	442.2

Rock-Tenn is an independent manufacturer of recycled paperboard and packaging products, with converting and distribution facilities for container, folding carton, solid fiber partition, fiber drum, specialty items such as book cover and furniture parts, and plastic products. The company is comprised of eight operating divisions: Recycled Fiber, Mill, Paperboard Products, Folding Carton, Partition, Corrugated Container, Plastic Packaging, and Ellis Paperboard

In 1990, Rock-Tenn's net sales reached $542 million. The company produced an estimated 675,000 tons of recycled paperboard and collected 750,000 tons of wastepaper.

In 1990, the Folding Carton Div. acquired Allforms Packaging Corp., the single largest supplier of folding cartons to the envelope industry for over 20 years. The Partition Div. has also expanded, with its latest acquisition of Box Innards Inc., a West Coast manufacturer of solid fiber partitions and pads. In 1991, Rock-Tenn acquired Ellis Paperboard Products, a specialized manufacturer of folding carton and fiber partitions. Ellis operates Dominion Paperboard Products Ltd. Rock-Tenn also purchased the Missiquoi mill in Sheldon Springs, Vt., from Specialty Paperboard Inc. and promptly realigned the mill's product mix of specialty grades to produce clay-coated recycled boxboard for the folding carton industry.

Production facilities:

EATON, IND.
Paperboard—150 tpd chipboard

OTSEGO, MICH.
Recycled board—250 tpd

CINCINNATI, OHIO
Recycled board—140 tpd

DELAWARE WATER GAP, PA.
Paperboard—145 tpd boxboard, clay-coated board

CHATTANOOGA, TENN.
Recycled paperboard—385 tpd

DALLAS, TEXAS
Recycled paperboard—435 tpd

LYNCHBURG, VA.
Recycled board—385 tpd

SHELDON SPRINGS, VT
(Missisquoi mill)
Recycled paperboard—175 tpd

Total production capacity:

PAPERBOARD	2,065 tpd

Scott Paper Co.

Scott Plaza
Philadelphia, Pa. 19113
Philip E. Lippincott, chairman/chief executive officer

(Scott Maritimes Ltd. is a wholly owned subsidiary. In 1986, Scott bought Bowater Industries plc's 50% ownership of Bowater-Scott Corp. Ltd. in a move to strengthen its European operations, and it renamed the unit Scott Paper Ltd.)

(million $)

	Net sales	Net earnings*
1990	$5,356.0	$148.0
1989	5,065.6	375.5
1988	4,726.4	400.9
1987	4,122.0	233.8
1986	3,437.0	186.5

*Includes the following major net nonrecurring gain (loss) in millions: 1990, (100); 1989, 73; 1988, 93.

Scott has honed its operations to two main segments: personal care and cleaning products and coated printing and publishing papers. It is the world's leading manufacturer of sanitary tissue paper products, and the S.D. Warren subsidiary is one of the largest producers of coated free-sheet in the U.S., with capacity of about 1 million tpy. Warren also makes uncoated free-sheet and specialty grades such as release papers and pressure-sensitive labels.

In early 1991, Scott management detailed a restructuring plan intended to reduce debt and invigorate performance. The company will sell most of its food service business, its specialty paper businesses, including the mill in Westbrook, Maine., and its bulk nonwoven business in the U.S. and Germany.

Sales by the personal care/cleaning segment were $4,090 million in 1990; sales by the printing/publishing papers segment were $1,267 million.

Capital expenditures were $815 million in 1990 and $791 million in 1989. At Scott's largest tissue operation, in Chester, Pa., a formerly idle line was rebuilt in 1990, and another rebuild is in progress. S.D. Warren expanded production of lightweight coated papers, hoping to cash in on the growth of catalogs and specialty magazines. In 1990, the company started up a $375-million lightweight coated paper machine at the Somerset mill at Skowhegan, Maine, and rebuilt a large, heavyweight coated paper machine at Muskegon, Mich. The Somerset machine's capacity for 220,000 tpy increased capacity at the mill by approximately 50%.

Capital spending for 1991 and 1992 was expected to be drastically reduced to $350 to $400 million each year. Plans for the rebuild of the pulp mill in Mobile, Ala., the new tissue mill in Owensboro, Ky., and a new tissue machine in Spain have all been delayed.

Scott owns 3 million acres of timberland in North America.

Production facilities:

(Scott does not release capacity data; information below is estimated.)

MOBILE, ALA.
(Southern Operations)
Pulp—1,400 tpd kraft; also deinked
Tissue—750 tpd
Uncoated free-sheet—498 tpd
Coated free-sheet—248 tpd
Cotton-fiber—99 tpd

SKOWHEGAN (Hinckley), MAINE
(S.D. Warren Div., Somerset mill)
Pulp—900 tpd bleached kraft (300 for market)
Coated free-sheet—1,289 tpd

WESTBROOK, MAINE
(S.D. Warren Div.—to be divested)
Pulp—300 tpd bleached kraft
Uncoated free-sheet—100 tpd
Coated free-sheet—347 tpd

WINSLOW, MAINE
(S.D. Warren Div.)
Pulp—485 tpd sulfite (pulp mill idle)
Tissue, toweling, waxing, coating-base, specialty—580 tpd
Uncoated free-sheet—100 tpd

MUSKEGON, MICH.
(S.D. Warren Div.)
Pulp—125 tpd bleached kraft
Coated free-sheet—397 tpd

FORT EDWARD, N.Y.
Tissue—180 tpd

CHESTER, PA.
Tissue—1,060 tpd

EVERETT, WASH.
(Northwest Operations)
Pulp—835 tpd sulfite (400 for market);
Tissue, towel—600 tpd

MARINETTE, WIS.
Tissue—350 tpd

OCONTO FALLS, WIS. (mill idle)
Toweling

NEW WESTMINSTER, B.C.
(Scott Paper Ltd.)
Pulp—70 metric tpd (94 short) groundwood
Tissue—300 metric tpd (330 short)

ABERCROMBIE POINT, N.S.
(Scott Maritimes Ltd.)
Pulp—735 metric tpd (810 short) bleached kraft (some for market)

CRABTREE, QUE.
(Scott Paper Ltd.)
Pulp—90 metric tpd (92 short tpd) deinked; 42 metrc tpd groundwoood (46 short tpd)
Tissue—170 metric tpd (187 short tpd)

HULL, QUE.
(Scott Paper Ltd.)
Tissue—222 metric tpd (245 short)

LENNOXVILLE, QUE.
(Scott Paper Ltd.)
Pulp—45 metric tpd (50 short) deinked
Tissue—45 metric tpd (50 short)

Total production capacity:

PULP	
Kraft	3,535 tpd
Sulfite	1,320 tpd
Groundwood	140 tpd
Deinked	142 tpd
Total	5,137 tpd
PAPER	
Tissue grades	4,332 tpd
Uncoated free-sheet	698 tpd
Coated free-sheet	2,281 tpd
Cotton-fiber	99 tpd
Total	7,410 tpd

Simpson Paper Co.

(Subsidiary of Simpson Investment Co.)
One Post St.
San Francisco, Calif. 94104
John Fannon, president

Financial data not available.

Having grown rapidly through acquisition, Simpson is probably the largest privately held paper company in the U.S. In late 1985, it purchased Champion International Corp.'s unbleached pulp, paper, and linerboard mill at Tacoma, Wash., thus marking a diversification from its white paper and market pulp operations. The mill integrated into Simpson's timber operations, bringing with it 240,000 acres of timberland.

The West Coast site is also well situated for exports to the Far East. In early 1987, the company bought a coated and uncoated printing/writing papers mill at Pasadena, Texas, from Champion International; Champion continues to supply wood and to market some of the products. In late 1987, Simpson bought the Plainwell, Mich., mill from Chesapeake Corp. to boost its output of premium coated printing papers at a site serving eastern markets. In 1990, Simpson purchased a small specialty papers mill in Gilman, Vt., from Georgia-Pacific Corp. In April 1990, Simpson closed a small rag-content paper mill in Middletown, Ohio. Later in the same year, Simpson acquired the West Linn coated papers mill from James River Corp. for $66.7 million.

Production facilities:

ANDERSON, CALIF.
Pulp—230 metric tpd bleached kraft
Printing/writing paper—420 tpd

FAIRHAVEN, CALIF.
Pulp—625 metric tpd bleached kraft (470 for market)

POMONA, CALIF.
Pulp—60 metric tpd deinked
Printing/writing paper—340 tpd

RIPON, CALIF.
Printing/writing paper—20 tpd
Fine papers—70 tpd

PLAINWELL, MICH.
(Simpson Plainwell Paper Co.)
Printing/writing paper—155 tpd
Release liner paper—110 tpd

VICKSBURG, MICH.
Fine papers—80 tpd
Special industrial paper—20 tpd

MIQUON, PA.
Fine papers—130 tpd

PASADENA, TEXAS
(Simpson Pasadena Paper Co.)
Pulp—725 metric tpd bleached kraft
Printing/writing papers—740 tpd

GILMAN, VT.
Security papers—n.a.

TACOMA, WASH.
Pulp—1,060 metric tpd bleached/unbleached kraft (245 for market)
Paper/board—880 tpd bag, multiwall, converting, linerboard

Total production capacity:

PULP	
Kraft	2,640 metric tpd
Deinked	60 metric tpd
Total	2,700 metric tpd
PAPER AND BOARD	
Printing/writing	2,142 tpd
Fine paper	265 tpd
Rag-content paper	20 tpd
Release liner paper	110 tpd
Special industrial	15 tpd
Paper/board	880 tpd
Total	3,432 tpd

Sonoco Products Co.

North Second St.
Hartsville, S.C. 29550-0160
Charles W. Coker, chairman/ceo

(million $)

	Net sales	Net earnings
1990	$1,669.1	$50.4*
1989	1,655.8	103.6
1988	1,599.8	96.3
1987	1,312.1	61.5
1986	963.8	54.7

* Includes $55-million restructuring charge.

Sonoco is a vertically integrated manufacturer of packaging products and the world's leading producer of tubes, cores, cones, and uncoated cylinder paperboard. In addition, it is one of the world's leading consumers of wastepaper.

Sonoco has grown through acquisitions. In 1987, it purchased Boise Cascade Corp.'s Consumer Packaging Div. (composite cans). In 1988, it bought Federal Paper Board Co. Inc.'s recycled boxboard mill at Richmond, Va., which increased Sonoco's recycled paperboard capacity to about 715,000 tpy and made it the largest U.S. producer of this grade. In 1991, Sonoco formed a joint-venture partnership with Coretech Corp. The company has also been quite active overseas, purchasing interests in Denmark, England, and Germany in 1989. And in August 1990, Sonoco purchased Lhomme SA of France. In 1991, Sonoco expanded its position in Canada through a joint-venture arrangement with Coretech, which included the purchase of a recycled board mill from Paperboard Industries Corp.

In 1990, the distribution of Sonoco's sales to unaffiliated customers was as follows: converted products (U.S.), 54%; paper (U.S.), 14%; international segment (mostly Europe and Canada), 18%; and miscellaneous, 14%.

Capital spending in 1990, not including acquisitions, was $117.6 million. Of this amount, $45 million was spent on the converted products segment, $20 million on the U.S. paper sector, and $34 million on international operations including Canada.

Sonoco owns 21,500 acres of timberland and controls an additional 23,700 acres.

Production facilities:

CITY OF INDUSTRY, CALIF.
Paperboard—75 tpd

ATLANTA, GA.
Paperboard—108 tpd

ROCKTON, ILL.
Paperboard—62 tpd

HOLYOKE, MASS.
Paperboard—210 tpd

AMSTERDAM, N.Y.
Paperboard—60 tpd

LANCASTER, OHIO
Paperboard—85 tpd

MUNROE FALLS, OHIO
Paperboard—70 tpd

DOWNINGTOWN, PA.
Paperboard—160 tpd

HARTSVILLE, S.C.
Pulp—300 tpd semichemical
Corrugating medium—450 tpd
Paperboard—550 tpd

NEWPORT, TENN.
Paperboard—280 tpd

RICHMOND, VA.
(Former Federal Paper Board Co. Inc. mill)
Recycled board—230 tpd

SUMNER, WASH.
Paperboard—65 tpd

BRANTFORD, ONT.
(Sonoco Ltd.)
Paperboard—122 metric tpd (134 short)

MONTREAL, QUE
(Sonoco Coretech Ltd.—50% owned)
Paperboard—100 metric tpd (110 short)

TERREBONNE, QUE.
(Sonoco Ltd.)
Paperboard—45 metric tpd (50 short)

Total production capacity:

PULP	300 tpd
PAPERBOARD	
Paperboard	2,249 tpd
Corrugating medium	450 tpd
Total	2,699 tpd

Southeast Paper Mfg. Co.

Box 1169
Dublin, Ga.
Robert F. Wilson, president

(Southeast is owned equally by Knight-Ridder Inc., Cox Enterprises Inc., and Media General Corp. Media General also owns Garden State Paper Co. Inc.)

(million $)

	Net sales	Pretax earnings
1990	$198.5	$4.4
1989	130.3	12.6
1988	115.2	30.1

Southeast Paper Manufacturing uses Garden State Paper Co. technology in producing newsprint from recycled newspapers.

In 1990, Southeast produced 438,000 short tons of newsprint vs. about 240,000 tons in 1989. The dramatic jump in production reflects the completion of a $330-million expansion program more than doubling its newsprint capacity to 460,000 tpy. The project also included new deinking facilities and expanded old newspapers' reclamation capacity to provide furnish for the new machine.

After having topped $182 million the year before, capital expenditures in 1990 dropped to $13 million and are expected to reach only $7 million in 1991.

Production facilities:

DUBLIN, GA.
Pulp—1,250 tpd deinked
Newsprint—1,250 tpd

Total production capacity:

PULP	1,250 tpd
PAPER	1,250 tpd

St. Joe Paper Co.

1650 Prudential Drive, Suite 400
Jacksonville, Fla. 32207
Winfred L. Thorton, chairman/chief executive officer

(million $)

	Net sales	Net earnings
1990	$610.0	$41.0
1989	635.3	67.2
1988	650.0	82.7
1987	596.3	57.2
1986	508.3	100.4

St. Joe has operations in five industries: forest products, rail transport, sugar cane production and processing, communications, and real estate.

Using timber from its land holdings, the forest products division, St. Joe Forest Products Co., produces nearly 500,000 tons of bleached linerboard and kraft paperboard each year at its Port St. Joe mill, which is used to produce corrugated boxes at the company's 16 container plants. Total 1990 revenue in this division was $366 million, and its operating profit was $7 million. The company spent a total of $104 million on capital improvements in 1990.

The company has adopted a four-year $207-million capital expenditure program for its St. Joe mill, including approximately $130 million in outlays to modernize equipment, improve environmental compliance, and implement new processes to further increase capacity and enhance the company's ability to produce high-performance, lighter-weight linerboard. The project is expected to boost production at the mill to 1,400 to 1,600 tpd by the end of 1993.

St. Joe owns 1.1 million acres of timberland in Florida and Georgia.

Production facilities:

PORT ST. JOE, FLA.
Kraft linerboard—1,400 tpd

Total production capacity:

PAPERBOARD	1,400 tpd

Stone Container Corp.

150 N. Michigan Ave.
Chicago, Ill. 60601-7568
Roger W. Stone, chairman/president/chief executive officer

(Stone Container acquired Consolidated-Bathurst for C$2.7 billion in March 1989. Con-Bath was renamed Stone Consolidated Inc. on Sept. 1, 1989. As part of the acquisition of Stone-Consolidated, Stone Container acquired a 25% interest in Celgar Pulp Co., which operates a market pulp mill in British Columbia. The merger created, at the time, the second-largest pulp, paper, and paperboard producer in the world, with sales of more than US$5 billion and capacity of approximately 8 million short tpy. The listing below includes Stone Consolidated's earnings [starting Mar. 1, 1989]. Stone acquired 49% stake in Empaques de Carton Titan, SA, one of Mexico's largest manufacturers of corrugated containers and molded cellulose products, in 1989.)

(million $)

	Net sales	Net earnings
1990	$5,755.9	$95.4
1989	5,329.7	285.8
1988	3,742.5	341.8
1987	3,232.9	161.3
1986	2,032.3	35.4

Through a series of acquisitions, Stone Container has grown from a second-tier player to the largest producer of containerboard and kraft paper in the U.S. It took advantage of industry downturns in the early and mid-1980s to acquire other companies at favorable prices using leveraged financing. The company held back on capital spending and used the strong cash flow generated by the 1986-87 industry recovery to reduce debt. In the future, however, the company may face significant capital outlays to modernize some of its higher-cost mills.

In 1990, sales reached $4.2 billion for paperboard and paper packaging and $1.3 billion for white paper and pulp. Pulp, paper/board, and converted products accounted for about 97% of the company's total sales.

Production in 1990, including 100% of Seminole Kraft Corp. and Stone Savannah River Pulp & Paper Co. and equity stakes in other affiliates, totaled 7.4 million tons and breaks down as follows: containerboard, 4.3 million tons; kraft paper, 531,000 tons; boxboard and other paperboard, 80,000; newsprint, 1.4 million tons; groundwood specialty papers, 352,000 tons; and market pulp, 718,000 tons.

Capital expenditures in 1990 totaled $552 million.

A $345-million expansion project at Consolidated subsidiary, Stone Savannah River Pulp & Paper Corp., was to be completed in 1991. The project is designed to add about 261,000 tpy of market pulp capacity to the mill and reduce the manufacturing costs associated with the existing production of linerboard.

Other projects include a $100-million, 30-month project to convert the majority-owned Jacksonville, Fla., mill to the production of recycled containerboard.

As of December 31, 1990, Stone Container owned approximately 14,000 acres of timberland in the U.S. and 343,000 acres in Canada. The company controls about 1.7 million acres in the U.S. and 11.4 million acres in Canada.

Production facilities:
(Figures for some production facilities are not available.)

UNCASVILLE, CONN.
Corrugating medium—230 tpd

JACKSONVILLE, FLA.
(Seminole Kraft Corp.—85% owned)
Pulp—1,470 tpd bleached kraft (Stone's share: 882 tpd)
Linerboard—1,084 tpd (Stone's share: 650 tpd)
Kraft paper—347 tpd (Stone's share: 208 tpd)

PORT WENTWORTH, GA.
Pulp—800 tpd unbleached kraft
Linerboard—981 tpd

HODGE, LA.
Pulp—1,400 tpd unbleached kraft; 300 tpd semichemical
Kraft papers—1,398 tpd
Corrugating medium—382 tpd

ONTONAGON, MICH.
Pulp—550 tpd semichemical
Corrugating medium—681 tpd

MISSOULA, MONT.
Pulp—1,900 tpd unbleached kraft
Linerboard—1,962 tpd unbleached

COSHOCTON, OHIO
Pulp—600 tpd semichemical
Corrugating medium—859 tpd

YORK, PA.
Corrugating medium—268 tpd
Specialty paper/board—118 tpd

FLORENCE, S.C.
Pulp—1,400 tpd unbleached kraft
Linerboard—1,394 tpd
Kraft paper—397 tpd

HOPEWELL, VA.
Pulp—1,000 tpd unbleached kraft
Linerboard—1,182 tpd

SNOWFLAKE, ARIZ.
(Southwest Forest Industries mill)
Pulp—700 tpd kraft; 200 tpd groundwood; 600 tpd deinked news
Newsprint—800 tpd
Kraft linerboard—450 tpd

PANAMA CITY, FLA.
(Southwest Forest Industries mill)
Pulp—660 tpd hardwood or fluff
Linerboard—800 tpd

Total production capacity:

PULP	
Kraft	8,580 tpd
Semichemical	1,450 tpd
Deinked	600 tpd
Groundwood	180 tpd
Total	10,810 tpd
PAPER AND BOARD	
Linerboard	7,300 tpd
Corrugating medium	2,420 tpd
Kraft paper	1,965 tpd
Newsprint	800 tpd
Specialty paper/board	118 tpd
Total	12,003 tpd

Stora

North American operations

Stora Forest Industries Ltd.
Box 59
Port Hawkesbury, N.S. B02 2V0
Tom R. Hall, president/general manager

(million C$)

	Net sales	Net earnings
1990	C$198.4	C$13.7
1989	220.3	29.4
1988	220.9	31.6

Stora Forest Industries Ltd., a wholly owned subsidiary of Stora, Sweden, is the largest forest products company in Nova Scotia. The sulfite pulp mill began operations in 1962, and a newsprint mill was added in 1971. The market pulp mill and newsprint mill, while having a common wood supply system, are two completely separate operations, with the entire market pulp production available to the world market. The newsprint mill is supplied by high-yield sulfite and stone groundwood operations.

Stora Forest Industries produces four grades of bleached sulfite market pulp, including Storafite 2000, which is bleached only with hydrogen peroxide. In 1990, the company produced 172,802 metric tons of newsprint and 145,443 metric tons of bleached sulfite market pulp.

Stora Forest Industries owns 56,197 acres of timberland and controls an additional 1,489,278 acres of crown land.

Production facilitiy:

POINT TUPPER, N.S.
(Stora Forest Industries)
Pulp—460 metric tpd bleached sulfite (for market); 125 tpd high-yield sulfite; 400 tpd groundwood
Newsprint—490 metric tpd

Stora Papyrus
(Formerly Papyrus Newton Falls Inc.)
Box 253
Newton Falls, N.Y. 13666
Leif Smedman, president/CEO

Stora purchased the mill in 1984 from McGraw Hill Inc. and American Broadcasting Co. In 1987, it placed Newton Falls Paper Mill Inc. under the Papyrus fine paper operations' umbrella. In 1991, the mill was renamed Stora Papyrus Newton Falls to more closely associate the mill with the parent company. The mill makes mostly coated two-side papers.

Production facility:

NEWTON FALLS, N.Y.
(Newton Falls Paper Mill Inc.)
Paper—400 short tpd (363 metric) fine

Total production capacity:

PULP	
Sulfite	440 metric tpd
High-yield sulfite	125 metric tpd
Groundwood	350 metric tpd
Total	915 metric tpd
PAPER	
Newsprint	425 metric tpd
Fine papers	363 metric tpd
Total	788 metric tpd

Temple-Inland Inc.

303 South Temple Drive
Diboll, Texas 75941
Clifford J. Grum, president/chief executive officer

(Temple-Inland Forest Products Corp. and Inland Container Corp. are wholly owned subsidiaries of Temple-Inland Inc.)

(million $)

	Net sales	Net earnings
1990	$1,892.5	$232.5
1989	1,894.2	207.4
1988	1,773.5	199.2
1987	1,602.7	141.4
1986	1,295.8	80.8

* Does not include financial services.

Container/containerboard
(Inland Container)

	Revenues	Operating profits
1990	$1,144.2	$150.9
1989	1,138.4	208.4
1988	1,093.1	221.3
1987	964.2	150.8
1986	721.7	38.8

Pulp/paperboard
(Temple-Inland Forest Products formerly Temple-Eastex Inc.)

	Revenues	Operating profits
1990	$373.0	$98.8
1989	368.3	114.9
1988	336.0	82.7
1987	292.5	53.4
1986	264.9	29.4

Temple-Inland is a holding company with major interests in paper, packaging, building products, and financial services. The company strives to gain a competitive advantage by being a low-cost manufacturer of a balanced blend of products, including specialty items having higher profit margins.

At the beginning of 1991, the company listed its annual capacity as follows: linerboard and kraft paper, 1,600,000 tons; corrugating medium, 540,000 tons; and bleached pulp and paperboard, 600,000 tons.

In 1990, Inland Container produced 1,539,000 tons of linerboard and kraft papers and 495,000 tons of corrugating medium. Approximately 81% of the containerboard was converted into corrugated containers at the company's box plants. Temple-Inland Forest Products produced 590,898 tons of paperboard and bleached pulp in 1990, up from 579,000 tons in 1989.

Capital expenditures for container and containerboard in 1990 totaled $163.0 million. Spending for pulp and papermaking operations was $33.3 million.

The company plans to build a a new 600-tpd mill in Maysville, Ky. The $176-million facility, which will produce primarily recycled linerboard but also corrugating medium and bag paper, is targeted for 1993.

The company owns 1,746,000 acres of timberland in the southern U.S. and controls 95,000 additional acres.

Production facilities:

NEWARK, CALIF.
(Inland Container)
Corrugating medium—175 tpd

ONTARIO, CALIF.
(Inland Container)
Recycled linerboard—625 tpd

ROME, GA.
(Inland-Rome; former Georgia Kraft Co. mill)
Pulp—2,200 tpd unbleached kraft
Linerboard—2,225 tpd

NEWPORT, IND.
(Inland Container)
Corrugating medium—650 tpd

NEW JOHNSONVILLE, TENN.
(Inland Container)
Pulp—450 tpd semichemical
Corrugating medium—650 tpd

EVADALE, TEXAS
(Temple-Inland Forest Products)
Pulp—1,650 tpd bleached kraft
Bleached board—1,650 tpd

ORANGE, TEXAS
Pulp—1,525 tpd unbleached kraft
Linerboard—1,525 tpd

Total production capacity:

PULP	
Kraft	5,375 tpd
Semichemical	450 tpd
Total	5,825 tpd
PAPERBOARD	
Bleached board	1,650 tpd
Linerboard	4,375 tpd
Corrugating medium	1,475 tpd
Total	7,500 tpd

Union Camp Corp.

1600 Valley Rd.
Wayne, N.J. 07470
R.E. Cartledge, chairman/chief executive officer

(million $)

	Net sales	Net earnings
1990	$2,839.7	$229.6
1989	2,761.3	299.4
1988	2,660.9	295.1
1987	2,361.7	207.5
1986	2,092.2	129.9

Union Camp owns four large-scale integrated mills producing linerboard, kraft paper, saturating kraft, printing and writing papers (uncoated bond, copy, tablet, duplicating, and offset papers), bleached board and bristols, and market pulp. Union Camp consumes a significant portion of its primary production internally to manufacture converted products such as corrugated boxes and grocery bags. In addition, UC has woodlands, chemicals, building products, and land resources operations.

In 1990, kraft paper and board shipments totaled 730,834 tons, and bleached paper and board shipments were 893,131 tons. Gross paper and paperboard revenues, including $576 million in intersegment sales, were $1,679 million. Converter shipments in 1990 were as follows: bags, 228,101 tons; containers, 936,446 tons; other, 47,037 tons. Packaging product sales in 1990 tallied $1,083 million.

Capital spending totaled $934 million in 1990 ($816 million for the paper and paperboard segment). In early 1989, Union Camp completed a $173-million modernization/expansion program at its Prattville, Ala., linerboard mill. The project increased capacity to 2,400 tpd.

In 1988, the company announced two major capital programs totaling $1.1 billion. The first—a $375-million, three-year modernization program at the Savannah, Ga., mill—includes a 1,300-tpd linerboard machine and retirement of two older machines. The program increases mill production by 150,000 tpy while reducing direct manufacturing costs by about 12%.

The second program, completed in mid-1991, is a $700-million expansion of the Eastover, S.C., uncoated free-sheet mill. The project provides an incremental 1,100 tpd, which will ultimately split out at 800 tpd of uncoated free-sheet and 300 tpd of bleached softwood market pulp. At the paper and board mill in Franklin, Va., Union Camp is installing a new bleach line that is to include proprietary technology that eliminates chlorinated organics.

Union Camp owns 1,652,000 acres of timberland in the U.S. South and controls an additional 12,000 acres.

Production facilities:
(Estimate of 1991 available capacity.)

PRATTVILLE, ALA.
Pulp—2,300 tpd kraft
Linerboard—2,500 tpd

SAVANNAH, GA.
Pulp—3,000 tpd kraft
Linerboard—1,650 tpd
Unbleached paper—1,350 tpd

EASTOVER, S.C.
Pulp—1,300 tpd bleached kraft (some for market)
Bleached paper—1,050 tpd

FRANKLIN, VA.
Pulp—2,000 tpd kraft
Bleached paper/board—1,975 tpd

Total production capacity:

PULP	8,600 tpd
PAPER AND BOARD	
Unbleached paper	1,350 tpd
Bleached paper/board	3,025 tpd
Linerboard	4,150 tpd
Total	8,525 tpd

United States Gypsum Co.

(Subsidiary of USG Corp.)
101 S. Wacker Dr.
Chicago, Ill. 60606
Eugene B. Connolly, chairman/chief executive officer

(Figures below are for USG Corp.)
(million $)

	Net sales	Net earnings
1990	$1,915	$-90.0
1989	2,191	28.0
1988	2,248	125.4
1987	2,898	204.3

USG Corp. was organized in January 1985 as the holding company for several operating subsidiaries that manufacture and market products for the building products and industrial processes markets. Gypsum linerboard is included in U.S. Gypsum's Gypsum Products operations; insulation board is part of Wood Fiber operations. U.S. Gypsum is the leading manufacturer of gypsum products in North America. The company accounts for a market-leading 36% of total gypsum board sales in the U.S.

U.S. Gypsum had sales of $928 million in 1990, compared with $1,032 million in 1989. The company's plants operated near capacity throughout 1990.

As part of a USG Corp. restructuring plan, U.S. Gypsum sold its construction and metal business and certain other plants in 1989. It also undertook several plant expansions. Among these was a second gypsum wallboard line, which opened at the Sperry, Iowa, plant in early 1989.

Production facilities:

SOUTH GATE, CALIF.
Gypsum board liner—200 tpd

JACKSONVILLE, FLA.
Gypsum board liner—225 tpd

NORTH KANSAS CITY, MO.
Gypsum board liner—105 tpd

CAMDEN, N.J.
Gypsum board liner—130 tpd

CLARK, N.J.
Gypsum board liner—390 tpd

OAKFIELD, N.Y.
Gypsum board liner—105 tpd

GYPSUM, OHIO
Gypsum board liner—105 tpd

GALENA PARK, TEXAS
Gypsum board liner—175 tpd

Total production capacity:

PAPER AND BOARD	1,435 tpd

Virginia Fibre Corp.

P.O. Box 339
Amherst, Va 24521
Charles R. Chandler, president/chief operating officer

(Virginia Fibre is a consolidated affiliate of Greif Bros. Corp.)

(million $)

	Net sales	Net earnings
1990	$79.6	$13.1
1989	87.0	19.9
1988	83.3	24.0
1987	75.1	16.1

(fiscal year ends Sept. 30)

Virginia Fibre is a major producer of semichemical corrugating medium. The company produced 266,000 tons of medium in 1989.

A $14.3-million, 500-tpd old corrugated container plant was started up in fiscal year 1990, completing Phase One of the company's mill modernization. Phase Two, defined as a rebuild of the stock preparation facilities, was completed in 1991 at a cost of $10 million. In August, the company said that daily production of medium set a new mill record of 943.4 tons. Also scheduled for 1991 is the startup of a landfill operation with an initial cost of $2.5 million.

Production facilities:

AMHERST VA.
Pulp—550 tpd semichemical
Corrugating medium—725 tpd

Total production capacity:

PULP	550 tpd
PAPERBOARD	725 tpd

Waldorf Corp.

2250 Wabash Ave., Box 64260
St. Paul, Minn. 55164
Gene Frey, president

(million $)

	Net sales
1990	n.a.
1989	n.a.
1988	136.8
1987	122.2
1986	108.1

(fiscal year ends June 30)

Waldorf reappeared as a name in the industry when Trident Associates Inc. bought two mills from Champion International Corp. and created a new company. It chose part of the name of Hoerner Waldorf Corp., which had operated a folding carton division bought by Champion in 1977. Champion had owned the St. Paul, Minn., mill and acquired the Battle Creek, Mich., mill along with St. Regis Corp. In addition to the two mills, Waldorf has six folding carton plants.

Production facilities:

BATTLE CREEK, MICH.
Recycled board—325 tpd

ST. PAUL, MINN.
Recycled medium—375 tpd
Recycled board—355 tpd

Total production capacity:

PAPERBOARD	1,055 tpd

Westvaco Corp.

299 Park Ave.
New York, N.Y. 10171
David L. Luke III, chairman
John A. Luke, president/chief executive officer

($ millions)

	Net sales	Net earnings
1990	$2,410.8	$188.2
1989	2,284.1	223.1
1988	2,133.9	200.4
1987	1,903.6	146.2
1986	1,811.9	108.1

(fiscal year ends Oct. 31)

Westvaco manufactures a broad range of high-quality papers for graphic reproduction, communications, and packaging in the U.S., and it has paper and packaging interests in Brazil. It is a major manufacturer of consumer and industrial packaging and one of the world's largest producers of envelopes. It also produces specialty chemicals and develops land for commercial and residential use.

Westvaco emphasizes higher-value-added, differentiated products, and it has one of the biggest budgets in the industry—more than $31 million in 1990. The company's new products include papers for high-quality printing and graphic arts, bleached paperboard to replace glass or plastic packaging, and saturating kraft used in decorative laminates. Westvaco's goal is to double the share of annual sales that comes from competitively distinctive products.

Sales of bleached pulp, paper, and paper products were $1,549.4 million in 1990, and unbleached paper and products sales were $629.6 million. The company's primary production of paper, paperboard, and market pulp was 2,512,000 tons.

Capital expenditures in 1990 were $472.1 million. The company spent $339.9 million on bleached pulp, paper, and paper products and $106.5 million on unbleached paper and paper products. Management has concentrated on belt tightening during the recent recession. The company stretched out the timing on the $530-million project for a new bleached paperboard machine and additional pulping and chemical recovery capacity at its Covington, Va., mill. The project is now targeted for mid 1993.

Westvaco owns 1,372,500 acres of timberland in the U.S. and 114,500 acres in Brazil.

Production facilities:

WICKLIFFE, KY.
(Fine Papers Div.)
Pulp—930 tpd bleached kraft (300 tpd for market)
Fine papers—600 tpd

LUKE, MD.
(Fine Papers Div.)
Pulp—1,075 tpd bleached kraft
Fine papers—1,400 tpd

TYRONE, PA.
(Fine Papers Div.)
Fine papers—200 tpd

CHARLESTON, S.C.
(Kraft Div.)
Pulp—2,600 tpd unbleached kraft
Paperboard—2,200 tpd

COVINGTON, VA.
(Bleached Board Div.)
Pulp—1,400 tpd bleached kraft; 170 tpd semichemical
Bleached board—1,700 tpd
Corrugating medium—300 tpd

Total production capacity:

PULP	
Kraft	6,005 tpd
Semichemical	170 tpd
Total	6,175 tpd
PAPER AND BOARD	
Fine papers	2,200 tpd
Corrugating medium	300 tpd
Paperboard	3,900 tpd
Total	6,400 tpd

Weyerhaeuser Co.

Tacoma, Wash. 98477
George H. Weyerhaeuser, chairman/chief executive officer

(Weyerhaeuser Canada Ltd. is a wholly owned subsidiary. Weyco owns 80% of North Pacific Paper Corp.; Jujo Paper Co. Ltd. of Japan owns 20%.)

(million $)

	Net sales*	Net earnings*
1990	$7,406.3	$340.3
1989	8,280.8	376.8
1988	7,862.5	515.8
1987	6,989.8	379.0
1986	5,652.0	179.6

*Weyerhaeuser Co. Does not include Weyerhaeuser Real Estate Co. or Weyerhaeuser Financial Services Inc.

Weyerhaeuser Co. is principally engaged in the gowing and harvesting of timber and the manufacture, distribution, and sale of forest products; real estate development and construction (Weyerhaeuser Real Estate Co); and financial services (Weyerhaeuser Financial Services Inc.). In 1989, the company embarked on an extensive restructuring effort designed to narrow its portfolio of businesses. By early 1991, Weyerhaeuser had sold or closed businesses that once had accounted for $1 billion of sales but, taken together, virtually no earnings. Subsequent dispositions, however, have been deferred as a downturn in the economic environment compromised prices forthcoming on the auction block.

Weyerhaeuser produces a diverse range of paper products. In 1990, output of air-dry pulp reached 1,386,000 metric tons; newsprint, 459,000 metric tons; paper, 900,000 short tons; bleached paperboard,217,000 short tons; and containerboard, 2,171,000 short tons. The company's pulp and paper segment recorded 1990 sales of $3.9 billion, with operating profits of $468 million. Weyerhaeuser's forest products segment recorded sales of $3.2 billion and operating profits of $312 million in 1990.

Capital expenditures (including acquisitions) for the pulp and paper segment tallied $713 million in 1990, and another $218 million was directed to forest products operations.

Major projects included the completion of the new $400-million, 425,000-tpy bleached pulp mill in Columbus, Miss. The pulp mill supplies furnish for an existing lightweight coated machine and helps Weyco maintain its status as one of the world's largest market pulp suppliers. Also, in 1991, the company started up a $300-million addition at its Longview, Wash., newsprint mill (NORPAC). The expansion features a 230,000-metric-tpy newsprint machine and one of the largest deinking facilities for the use of recycled newsprint in North America.

Weyerhaeuser owns approximately 5.6 million acres of commercial forestland in the U.S. (50% in the South and 50% in the Northwest), and it has long-term licensing arrangements for about 9 million acres of productive forest land in Canada. In addition, the company operates one of the nation's largest wastepaper recycling systems and is in the process of expanding annual capacity of paper and paperboard wastes to 1.7 million tons.

Production facilities:

COLUMBUS, MISS.
Pulp—260 tpd thermomechanical
Lightweight coated paper—570 tpd

NEW BERN, N.C.
Pulp—750 tpd bleached kraft (for market)

PLYMOUTH, N.C.
Pulp—1,000 tpd kraft (264 for market); 220 tpd semichemical
Linerboard—620 tpd
Corrugating medium—410 tpd
Uncoated free-sheet—850 tpd

VALLIANT, OKLA.
Pulp—1,900 tpd kraft; 410 tpd semichemical
Linerboard—2,010 tpd
Corrugating medium—570 tpd

NORTH BEND, ORE.
Pulp—300 tpd semichemical
Corrugating medium—550 tpd

SPRINGFIELD, ORE.
Pulp—1,150 tpd kraft
Containerboard—1,450 tpd

COSMOPOLIS, WASH.
Pulp—400 metric tpd sulfite (for market)

EVERETT, WASH.
Pulp—395 metric tpd kraft (for market)

LONGVIEW, WASH.
Pulp—780 tpd kraft (some for market); 200 tpd semichemical
Corrugating medium—320 tpd
Bleached paperboard—620 tpd

LONGVIEW, WASH.
(North Pacific Paper Co.—80% owned)
Pulp—1,375 tpd thermomechanical
Newsprint—1,440 tpd
(does not include new machine)

LONGVIEW, WASH.
(R-W Paper Co.)
Uncoated free-sheet—360 tpd

ROTHSCHILD, WIS.
Pulp—200 tpd sulfite
Uncoated free-sheet—350 tpd

KAMLOOPS, B.C.
(Weyerhaeuser Canada Ltd.)
Pulp—1,230 metric tpd (1,350 short) kraft (for market)

PRINCE ALBERT, SASK.
(Prince Albert Pulp & Paper, div. of Weyerhaeuser Canada Ltd.)
Pulp—920 metric tpd (1,010 short) bleached kraft (for market)
Uncoated free-sheet—600 metric tpd

Total production capacity:

PULP	
Kraft	8,900 tpd
Semichemical	835 tpd
Sulfite	515 tpd
TMP	1,540 tpd
Total	11,750 tpd

SECONDARY FIBER	
Total	3,400 tpd

PAPER AND BOARD	
Uncoated free-sheet	2,060 tpd
Lightweight coated	580 tpd
Newsprint	1,350 tpd
Bleached paperboard	625 tpd
Linerboard	4,085 tpd
Corrugating medium	1,865 tpd
Total	10,525 tpd

Willamette Industries Inc.

3800 First Interstate Tower
Portland, Ore. 97201
William Swindells, chairman/president/chief executive officer

(million $)

	Net sales	Net earnings
1990	$1,904.9	$129.6
1989	1,891.8	191.1
1988	1,716.0	161.1
1987	1,431.6	121.3
1986	1,200.2	74.7

Willamette Industries is a diversified, integrated forest products company with 75 plants and mills manufacturing containerboard, bag paper, fine paper, bleached hardwood market pulp, specialty printing papers, corrugated containers, business forms, cut-sheet paper, paper bags, inks, lumber, plywood, particleboard, medium-density fiberboard, and value-added wood products.

Willamette reports financial results for two business segments: Paper Group and Building Materials Group. The Paper Group includes fabricated paper products and pulp and paper. Pulp and paper sales to outside customers were about $378 million in 1990—20% of net sales. Total pulp and paper production in 1990 was 1,590,000 tons. Company pulp and paper capacity, as of Dec. 31, 1990, was 1,841,000 tons. Fabicated paper product 1990 sales were $917 million—48% of net sales. Production included 12.0 million ft^2 of corrugated containers, 251,000 tons of business forms, 49,000 tons of cut-sheet paper, 115,000 tons of kraft bags and sacks, and 330,000 tons of preprinted linerboard.

Total capital expenditures in 1990 were $346.6 million, $269 million of which went to Willamette's paper products facilities. Expected capital expenditures in 1991 were $270 million.

In 1990, the company completed construction of the 200,000-tpy uncoated free-sheet mill near Bennettsville, S.C. The mill more than doubles Willamette's production capacity for fine paper and repositions the company from being a net buyer to a net seller of fine paper.

Capital projects underway in 1991 include: construction of a medium-density fiberboard plant at Bennettsville, S.C.; modernization and expansion of the paper mill at Campti, La.; and construction of corrugated container plants in Sealy, Texas, and Fridley, Minn.

Willamette owns or controls 1,046,000 acres of forest in the U.S. Also, in August 1991, Willamette announced that it had agreed in principal to purchase Bohemia Inc., a wood products company based in the Pacific Northwest. The price tag was set at $122 million and would include 33,000 acres of timberland in Washington state.

Production facilities:

PORT HUENEME (Oxnard), CALIF.
Recycled paperboard (corrugating medium, linerboard)—408 tpd

HAWESVILLE, KY.
(Kentucky Mills: bleached pulp, fine paper)
Pulp—735 tpd bleached hardwood kraft (350 tpd for market)

HAWESVILLE, KY.
(Kentucky Mills)
Pulp—300 tpd semichemical
Corrugating medium—385 tpd

HAWESVILLE, KY.
(Kentucky Mills)
Fine paper—518 tpd

CAMPTI, LA.
(Red River Mill Div.)
Pulp—800 tpd unbleached kraft
Kraft linerboard—1,079 tpd

ALBANY, ORE.
Pulp—580 tpd kraft; 200 tpd semichemical
Kraft linerboard, paper—900 tpd
Corrugating medium—285 tpd

Total production capacity:

PULP	
Kraft	2,115 tpd
Semichemical	500 tpd
Total	2,615 tpd

PAPER AND BOARD	
Fine paper	518 tpd
Kraft linerboard, paper	1,979 tpd
Corrugating medium	670 tpd
Recycled linerboard, medium	408 tpd
Total	3,575 tpd